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In continuation of The Journal of the Department of Agriculture of Puerto Rico

MELVILLE T. COOK, Editor

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Volume XXI

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ANCIENT RECORDS OF BIRDS FROM THE ISLAND OF ST. CROIX WITH OBSERVATIONS ON EXTINCT AND LIVING BIRDS OF PUERTO RICO

By ALEXANDER WETMORE
United States National Museum

During the summer of 1934 Dr. L. J. Korn, working under the Museum of the American Indian, Heye Foundation, of New York City, excavated a kitchen midden on St. Croix in the Virgin Islands, from which he obtained a considerable collection of bones of birds. Identification of this material has revealed 23 species of birds, including a number of records of value as the following list will show. The collection has been of particular interest in view of my earlier studies of bones from middens on this same island from excavations made by Mr. Theodoor De Booy.[1] And, further, has been of importance in connection with some of the extinct species found also on Puerto Rico. The additional information regarding these former Puerto Rican birds is of definite value in connection with the fauna of that island.

The site was at a place known as Concordia on the south coast about one and one half miles east of Southwest Cape, which marks the extreme southwestern extension of the island. The midden was located about 400 yards inland from the beach and was about 30 inches in depth. Bones of mammals, birds, turtles and fishes were found to the bottom of the deposit, with more birds at the center level than elsewhere.

As with most material of this kind the exact age of it is not certain, except that it antedates the period of discovery, since the deposits do not include objects of European origin. The bird bones are in good condition except for breakage, and are entirely free of animal matter. It is assumed that they have an antiquity of between 500 and 800 years. The assemblage gives a definite picture of the larger species in the avifauna of St. Croix before the forests and lagoons were despoiled by Caucasian intrusion.

[1] See Proc. U. S. Nat. Mus., vol. 54, 1918, pp. 513–522, pl. 82.

The material is preserved in the collections of the U. S. National Museum. Drawings illustrating certain specimens have been made for me by Mr. Sidney Prentice.

PROCELLARIIDAE

PUFFINUS LHERMINIERI Lesson. Audubon's Shearwater.

Two humeri with the extremities somewhat broken represent this species without question. Audubon's shearwater was found earlier in De Booy's material from a midden on Magen's Bay on the north coast of St. Thomas, and is known to breed on Saba Island two and one half miles south of the western end of St. Thomas. The present record is the first report of it from the island of St. Croix.

PELECANIDAE

PELECANUS OCCIDENTALIS Linnaeus. Brown Pelican.

Represented by parts of two humeri and an ulna.

SULIDAE

SULA DACTYLATRA Lesson. Blue-faced Booby.

A cranium, measuring 40 mm. in transverse diameter across the occipital region, from its size is identified without question as this species. The specimen represents the only record for the blue-faced booby from this area, and is a record of considerable importance as it indicates a greater range for the species in prehistoric times than at present. While the blue-faced booby nested formerly in the Bahamas it has not been reported from the Virgin Islands or Puerto Rico. The nearest modern colonies of which I have record are on the Alacran reefs of Yucatán, the Grenadines and Los Hermanos Islands on the coast of Venezuela.

SULA LEUCOGASTER (Boddaert). Brown Booby.

Represented by a cranium, fragmentary humeri, ulnae, coracoids, a metacarpal and a tibio-tarsus, this species is easily recognized. The tibio-tarsus is distinctly larger than in *S. piscator*. The brown booby occurs today along the shores of St. Croix and Puerto Rico.

SULA PISCATOR (Linnaeus). Red-footed Booby.

A fragmentary humerus, a metacarpal and an ulna come from this species which in general is distinguished from the brown booby

by rather definite skeletal characters. The humerus which is almost the same in size in the two, in the present species has the ridge for the insertion of the *latissimus dorsi* muscle placed farther from the upper margin of the bone than in *Sula leucogaster*. The ulna and metacarpal are more slender.

ARDEIDAE

ARDEA HERODIAS Linnaeus. Great Blue Heron.

A broken pelvis, parts of three tibio-tarsi, and a broken femur come from this species, easily distinguished from other herons by larger size.

NYCTANASSA VIOLACEA (Linnaeus). Yellow-crowned Night Heron.

This common heron is represented by fragments of five humeri and two femora.

PHOENICOPTERIDAE

PHOENICOPTERUS RUBER Linnaeus. Flamingo.

Next to De Booy's Rail this species is the most common bird in the present collection, indicating that it was of regular occurrence, and calling to mind the statement of A. E. Newton[1] that "large bands of some species of flamingo x x x x are said to have formerly visited St. Croix periodically, and even of late years a few seem to have been occasionally observed." There has been no other report of this bird until now, and these bones seem to be the only specimens extant from St. Croix. The species seems to have been considerably reduced in numbers comparatively soon after the coming of white men.

ANATIDAE

CHEN sp.

The proximal half of a left humerus represents a goose of this genus, agreeing in size and outline with males of *Chen hyperborea hyperborea* (Pallas). It may be noted however that in the lesser snow goose and the blue goose the head of the humerus shows no differences, so that this fragment is not identified to species. The specimen is of definite interest in that it is the first indication of these birds in the Virgin Islands. As the lesser snow goose formerly came regularly to Cuba[1] it is probable that the St. Croix bird was of that form.

[1] Ibis, 1859, pp. 365–366.
[2] Barbour, T., Mem. Nuttall Ornith. Club, 1923, p. 42.

In my account of the Birds of Porto Rico and the Virgin Islands[1] I gave uncertain records of white geese for Puerto Rico under the name of the Greater Snow Goose. It seems more probable in view of the greater range and more extended migration of the lesser snow goose that these notes properly relate to the latter form.

MARECA AMERICANA (Gmelin). Baldpate.

This duck, rare in migration in the West Indies, is represented by the distal end of a humerus. It is still found at the proper season on St. Croix as H. A. Beatty[2] records one killed on Krause Lagoon on November 11, 1921.

DAFILA BAHAMENSIS (Linnaeus). Bahama Pintail.

Several humeri and a few other bones attest the presence of this resident form.

RALLIDAE

RALLUS LONGIROSTRIS Boddaert. Clapper Rail.

Five complete tibio-tarsi and eight fragments of the same bone indicate the presence of this inhabitant of mangrove swamps. It is of interest to record that Beatty[3] records this bird as "common in the mangroves bordering Krause Lagoon, the only place on the island where they are found." This locality is on the southern part of St. Croix not far from the kitchen midden where the bones noted above were obtained.

IONORNIS MARTINICA (Linnaeus). Purple Gallinule.

The lower end of a metatarsus comes from this handsome species which has not been recorded previously from St. Croix though it is of regular occurence in Puerto Rico. The metatarsus in this species is easily distinguished from that of the Florida gallinule by the larger, deeper and more distinctly marked depression for the hallux, and by the pronounced trough-like excavation of the posterior face. Toward the head the inner margin of the bone becomes a thin plate, entirely unlike other species of its family that I have examined, except *Porphyrio,* which has the same general conformation of this bone.

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[1] New York Acad. Sci., Scient. Surv. Porto Rico and Virgin Islands, vol. 9, 1927, p. 306.

[2] Journ. Dept. Agric. Porto Rico, vol. 14, July, 1930, p. 137.

[3] Journ. Dept. Agric. Porto Rico, vol. 14, July, 1930, p. 139.

NESOTROCHIS DEBOOYI Wetmore. De Booy's Rail.

The abundance of this curious rail and its importance as a food item among the St. Croix Indians is attested by the quantity of bones from the present deposit, there being remains of at least a dozen individuals and probably more. This rail and the flamingo are in fact the species most commonly represented. The rail material includes numerous femora and tibio-tarsi, several of them complete, and two humeri. One of the latter (*figs. 1–2*) is complete and shows the characters of this bone perfectly, previous specimens available having been more or less damaged. Though the humerus in all rails is relatively small, in *Nesotrochis*, when compared with other parts of the skeleton, this bone seems especially weak. The complete specimen has the following measurements: Total length 62.9, transverse breath of head 13.0, transverse of distal end 10.0, transverse breadth of shaft at center 4.2 mm. There can be no doubt that *Nesotrochis* did not have the power of active flight. The humerus mentioned is so important that drawings are given to show its characters, the specimen from Cueva San Miguel, Puerto Rico, that I have illustrated previously[1] having been defective at the lower end and on the crista superior due to corrosion from the soil in which it was preserved.

Most interesting in the present collection of bones of this species are the four specimens representing the metatarsus, which has been known previously only from a fragment, found in Puerto Rico, of the distal third of the bone. One of the present bones is complete except for slight breakage on the edge of the inner trochlea, another has the trochlea broken, and the remaining two are fragments of the head and the adjacent shaft. The complete specimen (figs. 3–7) is strong with well developed trochlea which are relatively heavy, with those at the sides less elevated above the central one than is usual in rails.

The facet for articulation of the hind toe is faintly indicated, less so than in any of the other rails examined, seeming to point to a slight and little functional development of that digit. The head is broad and strong and the shaft relatively heavy. The entire bone is decidedly reduced in length and strengthened in form when placed beside the metatarsus of such a species as *Aramides*. Following are

[1] Bull. Amer. Mus. Nat. Hist., vol. 46, May 22, 1932, figs. 8–9; New York Acad. Sci. Scient. Surv. Porto Rico and Virgin Islands, vol. 9, pt. 3, p. 34.

measurements of the complete specimen: Total length 71.5, transverse breadth of head 13.0, transverse breadth of trochlea 14.6, transverse breadth of shaft at center 5.9 mm. The broken specimen measures 13.5 mm. across the trochlea and 6 mm. across the center of the shaft. One of the fragments in only 5.4 mm. across the shaft.

The addition of the complete metatarsus to the skeletal elements of this species alters somewhat my earlier beliefs [1] as to the affinities of *Nesotrochis* among living rails. Principally from evidence obtained from the femur and tibio-tarsus I have believed it to be "a highly specialized off-shoot from the primitive stock that has produced *Aramides* and closely allied (but not ancestral) to that group of species." The metatarsus in the relative position of the trochlea and the form of the talon and adjacent parts is nearest the subfamily *Gallinulinae.* The tibio-tarsus has the head somewhat like that of *Aramides* while the distal end inclines toward the gallinules. Characters of the femur are much obscured by its heavier form so that this bone offers nothing of importance in considering relationships, while the humerus is so highly peculiar as to show no definite affinities.

After careful consideration and fresh comparisons of the additional material listed above I am led now to consider *Nesotrochis* a specialized form of the subfamily *Gallinulinae,* that so far as the New World is concerned has no close relatives. Curiously enough the modern species that I have seen whose skeleton is most similar to *Nesotrochis* is *Tribonyx mortierii* Du Bus of the distant island of Tasmania. Proportions of the lower limb are quite similar in the two species considered, though femur, tibio-tarsus and metatarsus are distinctly heavier in *Tribonyx.* The humerus is about the same in size in both. There is suggestion in these similarities not so much of close affinity as of a former wide distribution of a group of non-volant, cursorial forms of habits quite different from those of aquatic or marsh inhabiting species. While *Nesotrochis* may be now considered an aberrant member of the subfamily Gallinulinae there is suggestion that it may merit subfamily recognition when more is known of it.

It appears from information at hand even more certainly than before that De Booy's Rail was not a pond, lake or marsh frequenting bird that waded habitually in water, but instead a courser that

[1] Bull. Amer. Mus. Nat. Hist., vol. 46, 1922, p. 311.

ran over drier ground. It will be recalled that it has been found on St. Thomas, St. Croix and Puerto Rico. It is now known from the larger lower limb bones, part of the pelvis and the humerus. Additional discoveries will be awaited with interest.

LARIDAE

THALASSEUS MAXIMUS (Boddaert). Royal Tern.

An assortment of wing bones come from this common species.

ANOÜS STOLIDUS (Linnaeus). Noddy Tern.

Newton in 1859 thought that the noddy came to St. Croix but had no definite report for it. A humerus from the midden collection is the first definite record for the island.

COLUMBIDAE

COLUMBA LEUCOCEPHALUS Linnaeus. White-crowned Pigeon.

This common species is represented by an ulna and a humerus.

COLUMBA SQUAMOSA Bonnaterre. Scaled Pigeon.

An ulna, similar to that of the white-crowned pigeon but larger, is identified as this species.

ZENAIDA ZENAIDA (Bonaparte). Zenaida Dove.

This is a common species on St. Croix, of which four humeri and two ulnas have been identified. One humerus and the two ulnas are smaller than skeletons of this species at present in the National Museum collections, but the difference is considered within the range of individual variation.

Peters [1] recently has treated *Z. zenaida* as a subspecies of *Zenaida aurita.* While the two are clearly representative of the same type of dove it is my feeling that the uniform differences between them are considerable enough to warrant separation of the two groups as distinct species. I have therefore listed these bones under the name *Zenaida zenaida.* The differences between the two may be summarized as follows:

ZENAIDA ZENAIDA. Adult, grayer, paler above, below deeper reddish brown, slaty gray on abdomen and distinctly darker on under

[1] Auk, 1927, p. 585; Condor, 1934, p. 215.

tail-coverts; juvenile, paler above than adult, duller, less reddish brown, below, with under tail-coverts dark as in the adult.

Range, Bahamas and Greater Antilles (including Puerto Rico) to St. John, Tortola, Salt Island, and Virgin Gorda in the Virgin group.

ZENAIDA AURITA. Adult, darker and more rufescent above, paler below, with abdomen and under tail-coverts decidedly lighter; juvenile, darker above than adult, darker also on neck and chest but with under tail-coverts light.

Range, Saba, St. Bartholomew and St. Eustatius to Barbadoes.

Both show darker and lighter extremes due to the extent of brown in the plumage and an occasional individual of *aurita* has a considerable reddish suffusion over the abdomen and under tail-coverts, but such are separated from *zenaida* without difficulty. It is especially noteworthy that the differences between the two are as pronounced in juvenile individuals as in adults.

The Anegada Passage seems to be the dividing line in range of these two species.

I may note that earlier [1] I have listed *Zenaida aurita* from St. Croix on the basis of a record by Cory [2]. I now believe that this is erroneous and that this report by Cory refers properly to *Z. zenaida*. No other records of *aurita* have come from this island. The report of *aurita* from Virgin Gorda also I believe to be in error.

PSITTACIDAE

ARA AUTOCTHONES sp. nov.

Characters.—Tibio-tarsus similar to *Ara tricolor* Bechstein [3] but larger in transverse width; form slender when compared with larger macaws.

Type, U. S. Nat. Mus. No. 343033, left tibio-tarsus, from Concordia, southwestern St. Croix, Virgin Islands, collected in kitchen midden deposits in 1934 by Dr. L. J. Korn.

Remarks.—The left tibio-tarsus of a small macaw (figs. 8–9) is the most unexpected find in the entire collection, as there has been no previous report of such birds from St. Croix. The specimen is from

[1] Scient. Surv. Porto Rico and Virgin Islands, vol. 9, 1927, p. 398.
[2] Auk, 1891, p. 48.
[3] *A* [*ra*] *tricolor* Bechstein, Allg. Ueb. Vög., vol. 4, pt. 1, 1811, p. 64, pl. 1.

an individual that, while fully grown, was still immature as the bone is slightly spongy about the extremities. In size it is intermediate between such large species as *Ara macao* and *A. militaris* and the small *A. severa.* Its slender proportions and the more elongated ridges about the proximal end serve to show that it is truly a macaw and not an Amazon parrot like the large *Amazona imperialis.*

When compared with the tibio-tarsus of living macaws it is marked by slender form and a slightly greater posterior development of the proximal end. Aside from this its only peculiarity seems to rest in its dimensions which do not fall within those of any other species known.

It measures as follows: Total length 77.7, transverse breath across distal end 9.4, smallest transverse diameter of shaft 3.9 mm.

In the following list there are given the forms of macaws that have been recorded from the West Indies, with their distribution:

Ara tricolor Bechstein. Cuba, Isle of Pines.
Ara gossei Rothschild. Jamaica.
Ara erythrocephala Rothschild. Jamaica.
Ara sp. Haiti.
Ara guadeloupensis Clark. Guadeloupe, Martinique.
Ara martinica (Rothschild). Martinique.
Ara atwoodi Clark. Dominica.
Ara erythrura Rothschild. One of the West Indian Islands.
Anadorhynchus purpurascens Rothschild. Guadeloupe.

It is obvious that the relationship of the bird from St. Croix to any of the above is difficult to establish. There is only one, *Ara tricolor,* of which specimens are extant, the rest having been described or recorded on the basis of indefinite, uncertain and incomplete accounts of early travelers.

The tibio-tarsus from St. Croix is from a slightly larger bird than the Cuban macaw as shown by comparison with the lower end of the tibiotarsus in two skins of *Ara tricolor* in the National Museum collections. Further than this there is little that may be said about it except that it has the peculiar value of being the only specimen now known of any other species of the group from the West Indies, and that it is the only record for the region from which it comes, the nearest report for a macaw to the west being from Haiti, (none being known from Puerto Rico), and from the east and south from

Guadeloupe. While many uncertainties accompany the bone from St. Croix, particularly its affinity with the forms that have been described from the accounts of early travellers, it has seemed best to designate it by name rather than to leave it without such identification.

STRIGIDAE

GYMNASIO NUDIPES NEWTONI (Lawrence). Newton's Owl.

Two femora, one complete and one broken tibio-tarsus, and part of a humerus come from at least two individuals. Identification to subspecies is made on geographic grounds as these bones do not differ from a skeleton of *G. n. nudipes* from Puerto Rico.

CORVIDAE

CORVUS LEUCOGNAPHALUS Daudin. Puerto Rican Crow.

With eight more or less complete humeri and other bones of this crow in the present collection its former abundance in St. Croix is established, especially since this is the third site on the island from which bones of these birds have been obtained. De Booy secured it near the mouth of Salt River, and Mrs. Hugo Hark has forwarded specimens from a midden on the Richmond Estate near Christiansted. There can be no reasonable doubt that it was native on St. Croix and that it ranged the primitive forests of that island in some numbers. That it was a resident is rendered more certain by the fact that a number of the bones are from young birds that had either come from the nest or were only recently on the wing.

CORVUS PUMILIS Wetmore. Lesser Puerto Rican Crow.

This extinct crow, described from an ulna obtained in a cave deposit near Morovís, Puerto Rico, has been known until now only from the type specimen. It is of great interest to report a complete tibio-tarsus (figs. 10–12) from St. Croix that, on the basis of analogy in size, must be ascribed to this species, thus affording at one and the same time information on an additional skeletal element, and an extension of range to another island.

One of the principal characters in distinguishing *Corvus pumilis* has been size, the ulna being distinctly smaller than that of *C. leucognaphalus* and slightly larger than that of *C. palmarum*. This same degree of difference is found in the tibio-tarsus from St. Croix.

In three skeletons of *leucognaphalus* from Hispaniola the length of the tibio-tarsus varies from 82.8 to 85.1 mm. In seven *palmarum* from the same island this bone ranges from 71.9 to 77.4 mm. The specimen from St. Croix measures 78.1 mm. and as it carries about the same proportion of greater size as the ulna it is considered to be *pumilis*. It is appreciably heavier in shaft and extremities than the largest *palmarum* at hand so that there is no difficulty in separating it from that species.

Remembering that two forms of crow, one large and one small, range today in Cuba and Hispaniola, and that the finding of the extinct *pumilis* in Puerto Rico gave similar representation for that island, it is quite natural to discover the same combination on St. Croix. While *pumilis* is near *palmarum* additional skeletal material of both indicates that they are distinct.

The present find adds another interesting species to the avifauna of St. Croix.

EXPLANATION OF PLATE

Figs. 1–2.—Right humerus of De Booy's Rail, *Nesotrochis debooyi*, about natural size.

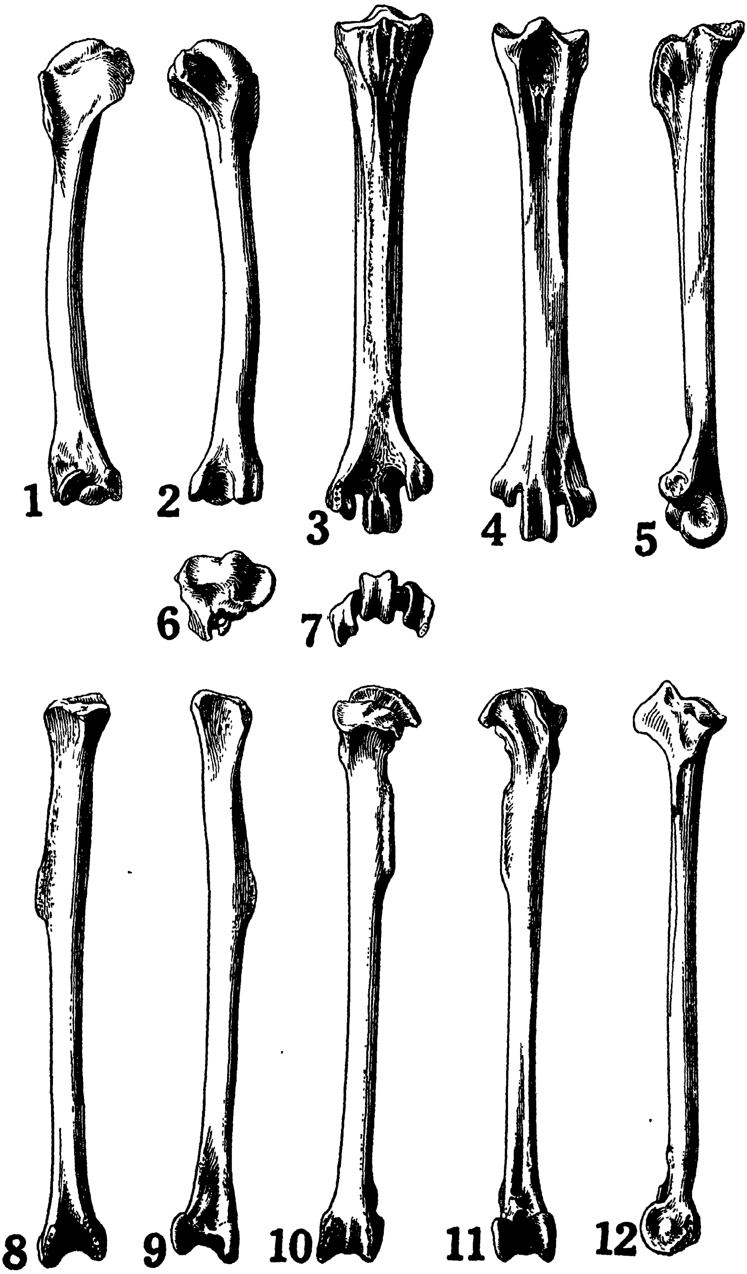
Figs. 3–5.—Left metatarsus of De Booy's Rail, *Nesotrochis debooyi*, about natural size.

Figs. 6–7.—Outline of head and trochleae of metatarsus of De Booy's Rail, *Nesotrochis debooyi*, about natural size.

Figs. 8–9.—Left tibio-tarsus of St. Croix macaw, *Ara autocthones*, about natural size.

Figs. 10–12.—Right tibio-tarsus of Lesser Puerto Rican Crow, *Corvus pumilis*, about natural size.

PLATE I



STUDIES OF THE NESTING ACTIVITIES OF LATIMER'S VIREO (*VIREO LATIMERI* BAIRD)

By NINA G. SPAULDING

The observations included in this paper were made at Algarrobo, which is situated about half way between Vega Baja and Manatí on the north coast of Puerto Rico. Here, a sandy, brush-covered coastal plain which includes Laguna Tortuguera and varies in width from about three to five miles, is abruptly terminated on the south by a series of steep, rugged, limestone hills. East and west the plain extends unbroken for miles.

This study was made on a five-hundred acre *finca* extending from the shore of Laguna Tortuguera, across the coastal plain, back into the first outcropping of limestone hills. Only a small percentage of this acreage was under cultivation. The remainder was overgrown with a low growth of scrub and brush. In sections, especially over certain parts of the coastal plain and in poorly kept pasture lands the growth was sparse. Other sections, including the hills were so densely wooded and tangled with vines that a path had to be cut in order to penetrate them. There were many small trails throughout the *finca*. It was the exact type of country favored by the species under consideration. A particularly attractive locality was a brushy pasture through which meandered a sluggish brook, bordered by a low growth of shrubs and trees.

The study in hand covers a period of three seasons, the first in 1927, from March 2 to June 20; the second, in 1930, from April 1 to May 27; the third in 1931, from January 27 to June 20.

Song.—The song of this species is exceedingly sprightly and vivacious. It usually consists of four syllables two of which are strongly accented. The accent most commonly falls on either the first and last or second and last syllables, as *moó-cha-che-píb; pa wé pa chú.* Sometimes only one accent occurs, as *pa-chibby-chú.* Syllables are occasionally increased in number, as *cha-icha-reécha-roók,* and sometimes decreased, as, *wé-pa-yoú.* One couplet may be sung at intervals of from one to three seconds and for a period of several minutes and then change to a different couplet and continue in the same manner. On February 10, for a period of two hours, a bird,

presumably a male, sang on an average of every 4 minutes and 16 seconds. Song activity occurs with the greatest frequency and vivacity from the time the male first acquires his territory, through courtship to about the middle of the nest construction period. From that time frequency and vivacity gradually wane, but it is the custom of the male to sing throughout the breeding cycle. The female sings also, but her singing is restricted to the courting season and in some individuals continues while nest building is in progress. One supposed female was noted constructing a nest (with her mate), who never uttered a note. When the female is in song, singing occurs responsively between the pair. At times responses follow so rapidly that at the climax, both birds are singing at once a most lively medley of all the varying couplets in their repertoire. Such an exhibition sometimes lasts unbroken for 20 minutes. One such was noted as early as February 26. This was during courtship. Another courtship display, sex undetermined, was the utterance of a rattle-like note, *chur-chur-chur-r-r-r* given loudly and sprightly with increasing rapidity, in response to a couplet sung by the mate. This species also has a love warble. It occurs so rarely that one is fortunate to hear it. One such exhibition consisted of one syllable uttered rapidly on the same pitch, with increasing rapidity, and finally terminating in a deliciously sweet-toned but almost inaudible series of liquid notes.

Responsive singing not only occurs between the two sexes, but also between two males (supposedly) in adjoining territories. When a mate enters the territory of another bird a lively duet ensues, and the intruding bird soon departs. One such event was noted when a pair were feeding near a nest they were building. One of the mated pair took no part in the singing.

Call Notes.—These were of three types: a grating, hoarse, cat-like mew; watchman's rattle-like *churr-r-r-r-rrr,* sometimes increasing in rapidity and accent, then diminishing and descending at the end, used at times as a scold note and at times in courtship, as has been stated, and *tup tup* often used as a conversational note by a pair when busy gleaning insects or nesting material together.

Territory.—This species has a well-defined territory, most easily determined preceding the time that the male acquires a mate. His voice is then heard daily within certain limited confines, beyond which he never seems to go. The nest is most frequently built on one of

its borders, and the rest is used as a feeding ground. In one instance the nest was placed in a line of trees and brush, beside which was a foot trail. Beyond that lay the feeding ground. It was quite densely covered with icaco (*Chrysobalanus icaco* L.). Territories are acquired at an early date. On my earliest arrival at the *finca* (Jan. 27), a solitary male whose activities were limited to one particular locality was noted. Day after day all day long his voice could be heard as he assiduously searched for insects within this limited area. He had chosen brushy pasture land, through which ran a sluggish, brush-bordered brook. Another male which had chosen for his territory a jungle-tangled hillside had a mate upon my first record of him (Feb. 3).

Nest.—The nest is cup-shaped and pendant. It is supported between two forked or parallel twigs, and is situated 3½ to 8 feet above the ground. It almost invariably overhangs an open space in the midst of a thicket, or else is found in a shrub or tree in a wind-break, bordering an open field, or in a border line of brush on the edge of a woods.

It is composed of 3 layers, the outer or camouflage, the foundation layer and the lining. The camouflage layer consists of bits of green moss, tan colored plant known and white spider egg sacs. This layer is unevenly distributed. Stems of Spanish or Florida moss (*Tillandsia usneoides* L) with the outside removed by decay, compose the foundation layer. The lining is a scanty layer of wiry, dried grass. Cobweb is employed to seal the nesting material over the two supporting twigs. We are indebted to Dr. Nathaniel L. Britton for identification of the Tillandsia stems, which have the appearance of black horsehair. When completed, the nest is a dainty, transparent affair and is so fragile that the incubating bird can be partially seen through the nest wall. Dimensions in inches average:

	Outside	Inside
Length	2½	2⅜
Width	2	1½
Depth	2¼	2⅛

The height of the nest-building season is in the early part of May. One nest observed was begun on the second of that month. Many completed nests are found by the 15th. My latest record for the beginning of nest building occurred on May 16. March 20 is my earliest record.

In the one case of entire nest construction which I had an opportunity to observe, the pair spent 10 days to the laying of the first egg, though the nest was practically finished in 6 days. Both birds shared in its construction until the afternoon of the 5th day, when the female, apparently, did all the work. The male continued to sing but no response came from the busy female. However, the male was a close attendant to his mate, hovered in the vicinity of the nest while the female was away searching for nesting material. Upon her arrival at the nest, he would sing in the bushes close by.

At the beginning of the nest, *Tillandsia* stems were dropped loosely over the two twigs from which the birds had chosen to suspend it. Later in the day, spider egg sacs were dropped into the dangling stems. Only three caught in its meshes. About 4 P. M., a loose combination of the pendant stems was effected, when twice one of the pair slipped between the supporting twigs, and by kicking and squirming matted and interweaved them to form the base of the nest.

During the second morning, the material brought consisted of spider egg sacs and two deposits of *Tillandsia.* At 12 M., the first load of plant down was brought. *Tillandsia* stems still dangled loosely.

By the 5th day the nest had been wholly closed beneath. Moss had been added and kicked through the matted *Tillandsia* stems to the outside. With the exception of one *Tillandsia* stem, moss continued to be the only material added that morning. In the afternoon, 4 loads of wiry, dried grass, 1 of *Tillandsia,* 2 of cobweb and 2 of plant down were deposited in the order given. The plant down was nestled through to the outside where it appeared with the green moss and spider egg sacs in the outer layer. Dried grass was the only material added on the 6th day. In the morning 10 loads were brought, averaging one every 17½ minutes. In the afternoon only 3 visits were paid to the nest, averaging one every 48 minutes. No song was uttered by the worker, indicating it to be the female. Singing by the male had markedly decreased, averaging one period every 18 minutes. Once, one of the pair uttered the love warble, sex unknown, but presumably, the male.

No nesting material was added after the 6th day to my knowledge. Stealthiness of movements increased. Singing by the female had ceased entirely by the 10th day, when the first and only egg was laid. The pair deserted the nest on the 12th day.

DATA REGARDING NESTS OBSERVED

Nest	Outside depth	Inside depth	Outside diameter	Inside diameter	Altitude	Tree	Time observed
1..	2¼″	2 ″	2¾″×2½″	2½″×2 ″	8 ft.	Guamá (*Inga laurina.* Willd) .. .	24 h
2..	1¾″	1½″	2¾″×2 ″	2½″×1½″	4 ft. 8 ″	Rama Menuda (*Myrcia splendens* Sw.) DC	1½ h
3..	2 ″	......	2½″×2 ″	......	5 ft. 8 ″	Pomarrosa (*Eugenia jambos L*) Br . .	5 h
4 .	...	..	2½″×2 ″	.	10 f′	(*Taonobo Stahlii. Kr & Urb*) Britton	0 h
5 .	2 ″	....	2½″×2 ″	.	4 ft. 8 ″	(*Taonobo Stahlii. Kr & Urb.*) Britton ..	2¼ h
6 .	2 ″	1¾″	2¾″×2 ″	2½″×1½″	3 ft. 7 ″	(*Taonobo Stahlii. Kr & Urb.*) Britton ..	1 h
7..	.....	......	....	....	......	(*Taonobo Stahlii Kr & Urb.*) Britton. .	0 h
8..	......	......	....	......	....	(*Miconia Thomasiana*) DC	1 h
9..	......	......	....	....	......	(*Miconia Thomasiana*) DC	½ h
10..	......	......	....	....	6 ft. 4 ″	Pomarrosa (*Eugenia jambos L*) Br. ..	6½ h
11..	2¼″	2¼″	2½″×1¼″	2 1/8″×1 2/8″	....	Icacó (*Chrysobalanus icaco L*)	2½ h
12..	2¾″	2½″	2½″×2¼″	......	....	(*Miconia Thomasiana*) DC Britton .	10 h
13 .	...	...	2½″×2 3/8″	...	....	Palo de María (*Calophyllum antillanum*)	3 2/3 h
14 .	2¾″	2¾″	2½″×2 3/8″	.....	5 ft. 9½″	Roble Blanco (*Tabebuia pallida*) Miers.	29 1/3 h
15	. .	. . ..	.. ..	. . .	. .	Aceituna Blanca (*Symplocos martinicensis*) Jacq.	0 h
Av.	2¼″	2 1/8″	2½″×2 ″	2 3/8″×1½″			

Eggs.—In life, the eggs are suffused with a roseate hue and are spotted with minute dots of reddish brown. A variation occurs in the size and number of these spots from a very sparse sprinkling to a considerable number. In most cases a wreath of more or less coalesced spots occurs around the larger end. In some instances these spots are a dark seal brown, including a few of pale lavender. The wreath is almost wholly absent when dots over the entire egg are sparse.

In one nest, two eggs that were laid before desertion, measured exactly alike: 20 mm × 13.2 mm. In another similar case, the two eggs measured: 19.5 mm × 14 mm. In still another instance, one egg, each in two different nests (one found on May 10 and the other on June 18 measured 3/4 inch × 9/16 inch. The height of the season for egg-laying is from the 10th of May to the 14th of June. The usual number in a clutch is 3, though one nest found in the process of incubation contained only 2 eggs. Earliest record of eggs laid: April 8 and 9. Latest: June 18.

Incubation.—A nest located on the 9th of June, 1930, offered the only opportunity for protracted observations on the incubating habits of this species. There were 3 eggs, which proved to be within 5 days of hatching. Incubation was shared by both sexes, but unequally, as one of the pair, which did not sing (supposed to be the female), averaged almost twice as much time on the nest as the singer (supposed to be the male).

The male sang when not on duty at the nest, but his voice was less vibrant and more casual than during the courting and nest-constructing periods, and was heard at rarer intervals. For these reasons and for the fact that no singing occurred when the male was incubating, it was difficult to locate nests after the beginning of this period. When he left the nest, it was his custom to sing at once from a near-by twig. There were a few exceptions when he omitted his song in the immediate environs of the nest, but instead, flew in silence across the foot-trail that separated the nesting tree locality from his feeding territory. His time was divided between these two sections. He seemed to like to hover in the vicinity of his nest and spent his time flitting from bush to bush, searching for insects, occasionally singing and sometimes preening.

Since the female did not sing when freed from incubating duties, it was not possible to follow her movements. She was never seen near the nest; in fact, she kept herself completely invisible.

The habits of the pair when covering the eggs, varied. The female almost invariably faced the fork in the branch from which the nest was suspended, while the male assumed a position at right angles to his mate, with bill propped against one of the supporting nest twigs and his tail against the other. The female was more alert and nervous. She moved her head frequently and sometimes completely changed her position. His movements were less frequent. At times when the male sang on a twig close to the nest, the female would become very alert, reach up her head and peer between the leaves as if to see him. Her behavior at such a time indicated his intentions. If he were ready to relieve her, she would look in all directions to see if it were safe for her to leave the nest, and then creep to the rim and drop out of sight. If he failed to approach, she would quietly settle back in the nest. If any other species of bird invaded her immediate vicinity, she was startled. The flapping wings of a Mocking Bird, and the sharp *tink* of a Bryant's Grassquit in the shrubbery close by would cause her to raise her head instantly and look all about.

The method of approach and departure from the nest was quite similar on the part of both birds. The approaching bird customarily alighted on the rim of the nest, or on a twig just above it. Usually the departure was slow and cautious up to the final dash, but there were exceptions when the exchange was made swiftly.

I did not see the male turn the eggs. In the morning on the day before the eggs hatched the female turned them at 11.50, 12, 12.09,

12.13, and 12.20; in the afternoon, at 5.12, 5.15, 5.34, 5.40, 6.05, and 6.13. At 5.50 she appeared to be turning the eggs, but when she raised her head she seemed to be eating something. I concluded she was cleaning the nest. At 6.26, this act was repeated. When turning the eggs, she sometimes accomplished it by tucking her head under her breast, and sometimes by standing and backing up against the side of the nest, then reaching down and moving the eggs with her bill. The nest wall was so thin that the bird was visible through it as she worked inside. Frequently she snuggled and cuddled as she settled over the eggs. Observations were made on this day from 10.40 A. M. to 1.06 P. M. and from 3 to 6.48 P. M. That night, before leaving, I flushed the incubating bird to see if the eggs had hatched. The bird permitted me to lower the branch before making her escape and offered no resistance.

On the day preceding the hatching of the eggs a more cautious behavior was noted on the part of both birds. For the first time they appeared conscious of my presence. This was seen by the manner of approach to the nest. They would come creeping along a twig behind the leaves to the nest and pause. The setting bird would fly or drop down out of sight, and the other would instantly slip inside the nest. I made observations from 9.53 to 12.18 that morning. Eggs were turned but once, and that by the female at 10.02. While the female incubated for 86 minutes the male spent 57 minutes near the nest and only 29 minutes across the trail.

The length of the incubating period remains undetermined. The height of the season occurs from about the 10th of May to the middle of June. Earliest record of an incubating pair: May 12; latest: June 9. Incubation was shared by both sexes, but unequally, as the female covered the eggs nearly twice as long as the male.

Rearing of Young.—The report which follows was obtained from observations of two nests, one of which was that of the incubating birds just described. The 3 eggs were found hatched on June 14. Observations were continued for three days. In the other, 2 eggs hatched on May 23, and the third on the 24th.

The height of the season occurs from about the 20th of May to the latter part of June.

Both parents shared in the parental duties of brooding and feeding, with the male feeding about four times as often as the female, and the female brooding about twice as much as the male. The young were closely brooded during the four days of observation, the exchange on the nest being effected at once by the pair. When

the young were left uncovered it was for periods of 5 to 8 minutes, and for this time, only once or twice during a day, for the first two days; on the third day with respect to one nest, five such occasions ocurred, with the longest period lasting 15 minutes.

Unless the female was ready to leave the nest on the arrival of the male with insects, he deposited them in her bill and she in turn mashed and fed them to the young. If she were ready to leave, she would usually fly and he would feed the young himself and remain to brood. Occasionally, the female would take a part of his load to eat, herself, before leaving the nest. Sometimes she would eat the whole load and continue brooding. The female never feeds her load of insects to the brooding male, but always directly to the young. When she arrives he departs. At times, on the approach of the male to the nest, the female repeatedly opens her bill wide and shuts it until he deposits the load in her mouth. Once the male was noted conducting himself in like manner, but she did not offer him any of her load and he flew. Both birds frequently uttered a metallic, *tsup tsup*, upon approach to the nest, evidently as a warning to the brooding bird to vacate. Insects were often mashed by both the male and female before they were given to the young. At times, after a deposit had been made in the gaping mouth of one of the young, it was withdrawn by the parent, mashed and redeposited. In one instance this was repeated 12 times before it was swallowed. On one occasion, when it was almost dusk, the male came with his last load for the day. It consisted of a larva that hung dangling from his bill, and was so big that the whole family had a meal from it. The female took it and her head disappeared into the nest. When she raised it, some of the worm was still visible in her bill. She held it out to him. He picked off a piece and ate it, and she ate the rest.

On more than one occasion the male arrived at the nest empty billed. He alighted on the twig immediately above it, and looked at his mate in the nest below him, then reached his head down toward her and eyed her slowly with one eye and then the other, with a very solicitous expression. She ignored his presence. He continued to look her up and down from head to tail and back again, but with no response. He then reached down until his bill almost touched hers. She still paid no attention. Presently, he pecked her bill three or four times. This produced no effect. He then hopped to the next twig above, looked back into the nest, crept along the twig and dropped downward. In 2 minutes he returned with an insect,

but the female did not let him brood until 19 minutes later. On another similar occasion when he touched her bill with his he poked it gently as if nudging her to make her fly and let him brood. She snapped her bill wide open and glared at him. He flew at once. Still another time he alighted on the twig just below the nest and reached his head up close to his mate's so their bills almost touched. They remained thus for 5 minutes.

Feedings averaged every 9½ minutes during the whole time observed at the nest which hatched on June 14.

Both birds attended to the cleaning of the nest. The excrement pellets were eaten.

These vireos are fearless in defense of their young. In the case of the May nest it will be recalled that two young and one unhatched egg were found in it, on the 23rd. On that day the brooding bird let me set up the camera within 2 feet of the nest. When I put my finger almost over him, he pecked at it. Not until I broke off a leaf above him, did he fly. He dashed back at once upon cessation of the disturbance. After all the eggs are hatched the behavior becomes fiercer and bolder. Upon approach to the nest to examine the young the brooding bird alighted on a near-by twig, spread his wings wide, fluttered and uttered his loud, shrieking, grating cat-like drawl, then flew at my face again and again, even daring to strike with his bill. He returned to the nest at once upon my departure. On the second day when the nest had been vacated by the parents for a few minutes, upon may approach to it, both of the pair instantly appeared in defense of the young, one flying at my head and the other bravely alighting in a bush at my feet. Upon my withdrawal, both continued their search for insects close by.

During the hottest part of the day the brooding bird would rise and stand, as if to cool the young. On one such occasion the bird remained thus for 3 minutes.

The young were naked and blind upon hatching. The general color was light reddish pink; the bill was creamy white; top of head, pale flesh color; back, reddish pink; wings the same, except for dark gray along the upper edge; chest reddish pink; belly dark gray; legs pinkish or flesh color. Wing quills began pricking through on the second day.

The young made little peeping sounds, but so faint that they were only audible when one's ear was close to the bottom of the nest.

A summary of observations on nest activities of the parents whose young hatched on June 14, follows:

	Observed	Singing							Brooding								
		No. of Periods	Average occurrence in Minutes	Total Number of Couplets	Maximum Number at a Period	Minimum Number at a Period	Maximum Time Silent	Minimum Time Silent	Number of Periods Male	Number of Periods Female	Total	Number of Minutes Male	Number of Minutes Female	Total	Average Male	Average Female	Minutes Young Unbrooded
June 14.....	8 h. 7 min.	40	12	170	18	1	48	1	8	9	17	154	306	460	18	34	
June 15.....	5 h. 38 min.	17	20	48	6	1	124	½	5	7	12	93	229	322	18	33	16
June 16.....	3 h. 37 min.	4	54	9	4	1	103	4	3	6	9	28	140	168	9	23	49
Total...	17 h. 22 min.	61	28	227	....	....	....	....	16	22	38	275	675	950	15	30	70

	Observed	Feeding						Excrement			
		Number—Male	Number—Female	Total	Average Frequency in Minutes	Longest Time Between Feedings	Shortest Time in Minutes Between Feedings	Times Eaten by Male	Times Eaten by Female	Total	Average in Minutes
June. 14............	8 h. 7 min.	48	8	56	8	30	1	4	12	16	30
June 15.............	5 h. 38 min.	22	7	29	11	40	1	3	11	14	24
June 16......... ...	3 h. 37 min.	17	7	24	9	27	3	1	2	3	72
Totals..........	17 h. 22 min.	87	22	109	9	......	......	8	25	33	42

The low average rate of cleaning the nest on the 16th may be due to the fact that on that date observations were not made until late in the afternoon and for a shorter time than on the previous days.

Behavior of Male upon Destruction of Mate and Young.—Unfortunately, the female and young in this nest (June 14) were destroyed between 7 P. M., on the 16th and 9.30 A. M., the on 17th. Feathers of the former were clinging to leaves above the nest and some were on the ground. Two notable changes were recorded in the behavior of the male. Frequency of singing increased and he flew beyond the confines of his territory. Wherever he went he always returned to the nest environs, but was never seen immediately at the nest. When in his feeding ground he flew so far beyond that his voice was barely audible. Previously, he had never fed south of the borderline

of brush in which the nest was located. Now, he flew so far in that direction that he was out of hearing. He was gone 29 minutes, then returned to the nest vicinity, still singing. He seemed to be searching and calling in all directions for his mate and nestlings. There was no pause in his singing. *Pa chibby chú* he sang. The last syllable had an unmistakably plaintive quality. The 19th was the last day of observation. The bird was still flying far afield but never failed to return to his territory. His singing was constant, but subdued and colorless. When he flew east of the nest (a direction not included in his territory, except for a matter of a few feet), and continued so far that his voice became barely audible, I followed him and overtook him singing in a *Miconia* bush, a few feet from the trail that led back, past his nest, and there I left him.

More data is needed to determine the length of the incubating season and the time from the hatching of the young to their departure from the nest, also a more extended study of the nestlings and of other problems that arise in the mind of the observer that still remain unsolved.

Explanation of Plates

Habitat of Latimer's Vireo (*Vireo latimeri* Baird)

Fig 1.—Nest in lower branches of tall tree on left; feeding ground on right of trail.

Fig. 2.—Feeding territory, overgrown with *icaco* brush.

Fig. 3.—Nest of Latimer's Vireo (*Vireo latimeri* Baird). Shows white spider sacs at base of nest.

Fig. 4.—Eggs of Latimer's Vireo (*Vireo latimeri* Baird). Laid April 8 and 9, an exceptionally early record. Nest deserted.

Fig. 5. Brooding bird.

Fig. 6.—Bird feeding young.

Fig. 7.—Nest of Latimer's Vireo (*Vireo latimeri* Baird). Excepitonal. Outer layer of gray lichen; no spider egg sacs or moss. Never occupied.

PLATE II

PLATE III

PLATE IV

6

7

A FARM MANAGEMENT STUDY OF 224 COFFEE FARMS IN PUERTO RICO, 1934 *

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DESCRIPTION OF THE AREA STUDIED

LOCATION

The coffee farms included in this study are all located in the coffee region of Puerto Rico, which comprises practically all of the west central mountain section of the Island (figure 1).

This study is based on records of farm businesses in the municipalities of Mayagüez, Las Marías, Añasco, Moca, San Sebastián, Lares, Utuado, Adjuntas, Jayuya, Ciales, Ponce, Juana Díaz, Villalba, Guayanilla, Peñuelas, Yauco, Sabana Grande, San Germán, and Maricao (figure 2).

CLIMATE

The mean annual temperature in the coffee area of Puerto Rico ranges from 68 degrees Fahrenheit in the higher sections to 76 degrees in the sections of lower elevation.

The average yearly rainfall ranges from 60 to 120 inches. Rainfall is not evenly distributed throughout the year, thus accounting for the so-called wet and dry seasons. The wet season usually starts in May and lasts until October, while the dry season includes from November to April.

Abundance of sunshine and a continuous growing season throughout the year are characteristic of Puerto Rico, as well as of other tropical countries.

SOILS

Practically all of the soils in the area studied are of a clayey nature, generally lacking in lime and in organic matter.

* A thesis presented to the faculty of the Graduate School of Cornell University, June 1936, in partial fulfillment of the requirements for the degree of Master of Science in Agriculture.

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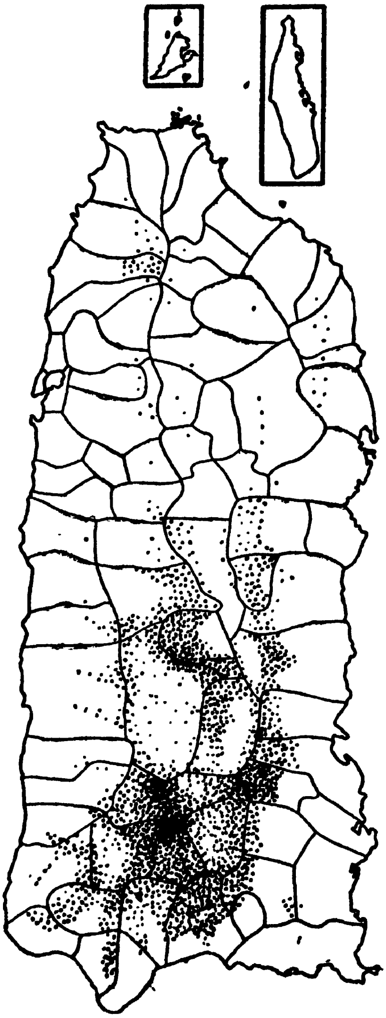

FIGURE 1. ACRES IN COFFEE IN PUERTO RICO, BY MUNICIPALITIES*
1 dot represents 100 acres.

* Puerto Rico Agricultural Experiment Station Bulletin 41, Types of Farming in Puerto Rico, p. 31. Based on U. S. Census, 1930.

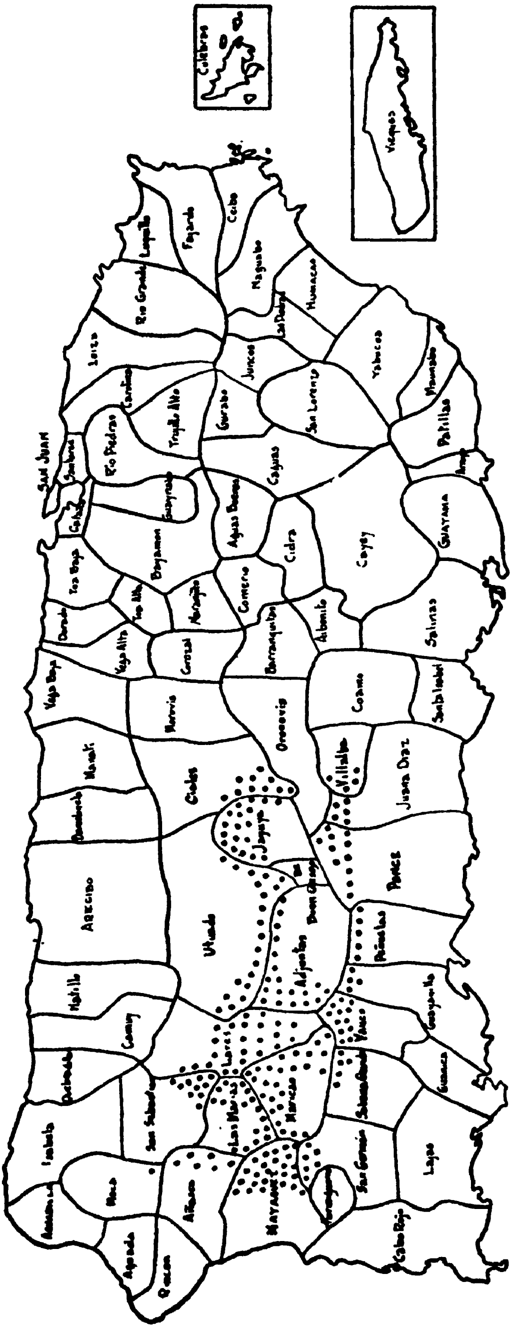

FIGURE 2. LOCATION OF THE FARMS STUDIED, BY MUNICIPALITIES

1 dot represents 1 farm.

The predominating soils in the coffee area of Puerto Rico are classified as Catalina, Frontón, Descalabrado, Utuado, Múcara, Moca, Viví and Cialito series, according to the soils survey of the Island.

TOPOGRAPHY

The elevation ranges from 500 to 2,500 feet above sea level in the area where coffee is grown in Puerto Rico.

TRANSPORTATION FACILITIES

Due mostly to the rough topography, transportation facilities are not very good. Several important insular highways run across the area, and many other gravel or dirt roads are also to be found. These, however, do not supply the entire needs for roads, and thus a large number of farms are to be found entirely off the roads, and are accessible only on horseback.

Of the 224 farms studied, 46 per cent were located on highways, 17 per cent were on gravel or dirt roads, and 37 per cent were entirely off the roads.

DEFINITIONS

CUERDA

The unit of land measure in Puerto Rico. It corresponds very closely to the acre, since it is equivalent to 0.9712 acres.

TOTAL CUERDAS IN CROPS

The total area planted to crops on a farm. Does not include permanent pasture, wooded pasture, or woods.

NET CUERDAS IN CROPS

From the total *cuerdas* in crops, subtract the *cuerdas* intercropped and double-cropped, to obtain the net *cuerdas* in crops. Represents the total area that was actually under cultivation.

ANIMAL UNIT

A measure of the average number of animals kept on a farm during a year, based on the amount of feed consumed and value of manure produced. A mature cow, bull, horse, mule, 2 heads of young stock, or 100 hens are each considered as one animal unit.

MAN EQUIVALENT

The average number of persons working on a farm during a year, reduced to an adult-male basis. It is obtained by adding the total months of labor on the farm, including 12 months for the operator, and dividing by 12.

CAPITAL INVESTED

The value of all farm property, land, houses, buildings, livestock, feed, seed, and equipment. The average of the amounts at the beginning and end of the year is considered as the capital invested in the farm business. It is also termed farm capital.

RECEIPTS

Total farm receipts or gross receipts include: 1, the amount received for all crops sold plus the value of the crops at the end of the year which were to be sold; 2, the amount received from the sale of livestock; 3, the amount received from livestock products sold; 4, the amount received from miscellaneous sources, such as work off the farm and rent of farm buildings; 5, the amount by which the farm capital at the end of the year exceeded that at the beginning

EXPENSES

Include all farm business expenses. In order to put all farms on a comparable basis, the value of the unpaid family labor, except that of the operator himself, was charged as an expense at what it would have cost to hire the work done. Value of livestock purchases, of new equipment or buildings, and repair of buildings and equipment were also included as expenses. When the farm capital at the end of the year was less than that at the beginning, this decrease in inventory was included as an expense. Household or personal expenses were not included.

FARM INCOME

Is the difference between total receipts and total expenses on a farm during a year. It represents what the farmer received for his year's work and for the use of all the capital invested in the farm business.

LABOR INCOME

Is the farm income less interest at 8 per cent on the average farm capital. It is what the operator received for his year's work in addition to having a house to live in and privileges from his farm.

Labor income is not comparable to the salary of a person living in a city. It is comparable, however, to the wages of a married hired man who is given a house and farm privileges besides his cash wages.

The labor income made on a farm is one of the best measures of its efficiency.

FARM PRIVILEGES

The value of all the products, such as milk, eggs, wood, charcoal, and livestock produced for home consumption, together with the estimated rental value of the farm house, constitute the farm privileges of a farmer.

LABOR EARNINGS

To the labor income add the value of the farm privileges, and this gives the labor earnings. This figure is more nearly comparable to the salary of a married hired man working in town.

RETURN ON CAPITAL

From the farm income subtract the estimated value of the operator's labor and management, to obtain the return on capital. In estimating the value of his work, the operator was advised to base his estimate on what it would have cost him to hire the work done by himself, in addition to the farm privileges he obtained during the year.

Since farm income, as already defined, is the income from capital and operator's labor, the return on capital is obtained by subtracting the value of this labor from the farm income.

PER CENT RETURN ON CAPITAL

This is the return on capital, as given above, expressed as a percentage of the average farm capital.

It is a very good measure of profits on a corporation type of farm with a large capital investment and where the owner does not run his business himself, but hires a manager.

CROP INDEX

The yield per *cuerda* of all crops on a farm, when expressed as a percentage of some base, is the crop index on this farm. For this study, the base used was the average yields during 1934 of all the farms studied. This base was considered as 100. If, for example, a farm had a crop index of 75, this means that the yields of all the

crops on that farm, averaged together, were 75 per cent of the yields of the same crops on all the farms.

The crop index was weighted by the acreage planted to each crop. For example, if a farmer had 30 *cuerdas* of coffee, and 10 *cuerdas* of bananas, the coffee received three times as much weight in the crop index as the bananas.

Since coffee was the main crop on each of the farms included in this study, the crop index for each farm is very heavily weighted by the acreage of coffee. Hence, the crop index and the yield of coffee per *cuerda* on most farms were about the same.

LABOR COSTS PER CUERDA IN CROPS

Include the cash cost of the hired labor, together with the cost of the board furnished to this labor, divided by the net *cuerdas* in crops on each farm. The value of the operator's labor or of the unpaid family labor was not included.

CAPITAL TURNOVER

Is the number of years required for receipts to equal capital. The capital turnover of a farm is obtained by dividing the average farm capital by the total receipts.

METHOD OF PROCEDURE

The survey method was used in making this study of coffee farms in Puerto Rico. The survey blank used consisted of two parts: the economic part, on which this study is based; and the agronomic part, which covered as nearly as possible all the phases and problems of coffee farming in Puerto Rico. Each farm, after being surveyed, was thoroughly inspected by the enumerator and the farmer. The records were taken during February to April, 1935; and the information obtained refers to the calendar year 1934.

The sample consisted of 224 farms, selected at random, in the most important coffee municipalities, based on the acreage on coffee in each of these municipalities, as reported by the 1930 census. No farm was included which did not have at least 6 cuerdas of bearing coffee or which did not get a major portion of its receipts from coffee.

Office tabulation, labor-income summaries, and business analyses for each farm were made at the Department of Agricultural Economics of the University of Puerto Rico, under the supervision of the author. Further tabulations, sortings, and cross-tabulations of the data were made by the author at Cornell University.

SIZE OF FARMS AND USE OF THE LAND

The 224 farms surveyed for this study covered a total area of 41,241 *cuerdas,* of which 26,123 *cuerdas* were planted to different crops. Of these, 4,524 *cuerdas* were intercropped and 208 double cropped, leaving a total of 21,373 *cuerdas* net in crops (table 1).

Intercroppings consisted, for the most part, of banana and orange trees. Banana plants provided most of the temporary shade required by the coffee bushes. Orange trees were used to quite an extent to provide part of the permanent shade.

Double cropping is not characteristic of a coffee farm. It occurs only in those sections where tobacco is also one of the main cash crops, the land planted to tobacco being used for vegetables and minor crops after the tobacco crop has been harvested.

Wooded pasture, which occupied 19 per cent of the area, was in practically all cases land in preparation for coffee plantings. Much of this wooded pasture was planted to shade trees to replace those destroyed by the 1928 and 1932 hurricanes.

Permanent pasture accounted for 7,110 *cuerdas*, or 17 per cent of the total area. The rest of the land in these farms was devoted to woods (1,729 *cuerdas*), occupied by buildings, roads and fences (1,709 *cuerdas*), or actually waste land (1,532 *cuerdas*) entirely unfit for agriculture.

The average size of farm was 186 *cuerdas,* of which 96 *cuerdas* were devoted to crops, mostly coffee; 35 *cuerdas* to wooded pasture; 32 *cuerdas* to permanent pasture; 8 *cuerdas* to woods; 8 *cuerdas* occupied by buildings, roads and fences, and 7 *cuerdas* of waste land.

TABLE 1. SIZE OF FARMS AND USE OF THE LAND

224 COFFEE FARMS, PUERTO RICO, 1934

	Total for all farms	Average per farm	Per cent of total
	*cuerdas**	*cuerdas*	
Total in crops	26,123	117	....
Intercropped	4,542	20	....
Double cropped	208	1	....
Net in crops	21,373	96	52
Permanent pasture	7,110	32	17
Wooded pasture (maleza)	7,788	35	19
Woods (monte)	1,729	8	4
In buildings, roads, and fences	1,709	8	4
Waste land	1,532	7	4
Total in farm	41,241	186	100

*The *cuerda* is the unit of land measure in Puerto Rico. Equivalent to 0.9712 acres.

FARM CAPITAL

The average farm capital for all farms studied was $15,580 (table 2). Of this, 95.8 per cent was invested in real estate, 1.8 per cent in livestock, and 2.4 per cent in equipment. The total investment per *cuerda* averaged $84.

The value of the land alone constituted 83.4 per cent of the total investment per farm, and averaged $70 per *cuerda*.

The value of the operator's house accounted for 5.2 per cent of the total investment. That of the buildings, of which houses for the "arrimados" were most important, represented 4.0 per cent of the farm capital. An "arrimado" is a hired man who is given a house to live in and usually a tract of land for a home garden. This type of hired man is characteristic of the coffee region of Puerto Rico, and may also be found in the tobacco areas, but is unusual in the sugar cane belt.

TABLE 2 FARM CAPITAL

224 COFFEE FARMS, PUERTO RICO, 1934

	Average value per farm	Per cent of total
Land	$12,997	83.4
Operator's house	808	5.2
Machinery house	388	2.5
Other buildings	629	4.0
Glacis*.	104	0.7
Total real estate	$14,926	95.8
Livestock	286	1.8
Equipment	368	2.4
Total	$15,580	100.0

* Glacis is a concrete floor for drying coffee in the sunlight

CROPS GROWN

Coffee culture in Puerto Rico is mainly a single crop type of agriculture. The acreage planted to coffee, both bearing and non-bearing, constituted 75.9 per cent of the total *cuerdas* in crops on these 224 farms in 1934 (table 3).

Bananas were second in importance as to acreage, and represented 11.7 per cent of the total *cuerdas* in crops. The banana plant constituted the most widely used type of temporary shade for coffee in Puerto Rico, because of its rapid growth, excellent shade, and its use for family consumption, hog feed, and as a source of cash income.

Citrus, especially oranges, occupied 5.2 per cent of the total *cuerdas* in crops. They were used as permanent shade, and were usually planted along the sides of the farm roads and lanes. The use of

citrus for shade has no particular advantage, besides the small income that may be derived from the crop, because of its susceptibility to certain insect and fungus pests that may also attack coffee. The present tendency of most coffee farmers is to eliminate citrus of all kinds from their coffee farms; but, as yet, the progress of this movement has been slow.

Other minor crops besides bananas, including plantains, corn, beans, yautías, and pigeon peas, together constituted 4.5 per cent of the total *cuerdas* in crops. These crops were mostly for home use.

TABLE 3. CROPS GROWN

224 COFFEE FARMS, PUERTO RICO, 1934

Crops	Total for all farms	Average per farm	Per cent of total
	Cuerdas	*Cuerdas*	
COFFEE:			
Non-bearing	8,243	36.8	31.6
Bearing	11,577	51.7	44.3
Total	19,820	88.5	75.9
CITRUS:			
Oranges	1,212	5.4	4.6
Other citrus	61	0.3	0.3
Non-bearing	58	0.3	0.3
Total	1,331	6.0	5.2
MINOR CROPS:			
Bananas	3,076	13.8	11.7
Plantains	136	0.6	0.5
Corn	345	1.5	1.3
Beans	246	1.1	0.9
Yautías	133	0.6	0.5
Pigeon peas	118	0.5	0.4
Other	207	0.9	0.9
Total	4,261	19.0	16 2
Sugar cane	192	0.9	0.8
Tobacco	302	1.3	1.1
Used by share-croppers	217	0.9	0.8
Total crops	26,123	116.6	100.0
Less: Intercrops	4,542	20.3	17.4
Double crops	208	0.9	0.8
Net cuerdas in crops	21,373	95.4	81.8

Sugar cane was the second most important cash crop on seventeen coffee farms, where the soil was especially adapted or where transportation facilities from the farm to the sugar mill were exceptionally good.

Tobacco was an important cash crop on 21 of the coffee farms. On these farms the income from this crop was a real help to the farmer, especially after the hurricanes; because, being an annual crop, it provided him with a source of income to help meet the large expenses involved in the rehabilitation of his coffee farm.

Of the total *cuerdas* in crops 17.4 per cent was intercropped. Intercropping is characteristic of the Puerto Rican coffee farms as they are today. A large percentage of the acreage in bananas and citrus was intercropped with the coffee.

Double crops were found almost exclusively in those farms which also grew tobacco, the land being planted to minor crops after the tobacco had been harvested. On these farms the system of share-croppers was also found. The area worked by share-croppers represented about 1 per cent of the total *cuerdas* in crops.

Net *cuerdas* in crops represented 81.8 per cent of the total *cuerdas* in crops or an average of about 96 *cuerdas* per farm. Of these 96 *cuerdas,* 88.5 were in coffee with bananas and citrus intercroppings. The balance was mostly in minor crops, tobacco or sugar cane.

AGE OF COFFEE BUSHES

The total *cuerdas* in coffee of all ages was 19,820 *cuerdas.* Of these, 8,243 *cuerdas,* or 42 per cent were from one to three years of age; 4,961, or 25 per cent, were from four to eight years old; and 6,616, or 33 per cent, were nine years old or more. Very few, if any, were more than twenty-five years old (table 4).

Under normal conditions in Puerto Rico, coffee bushes do not generally start to bear until after the third year. They will then bear lightly, and will reach full bearing capacity during the sixth or seventh year.

Of the area in coffee in these farms, 42 per cent was under bearing age and 58 per cent was either just starting to bear or in full bearing during 1934.

The new coffee plantings set after the 1928 hurricane would have started to bear by 1932, had it not been for a second hurricane in that year. Since this last hurricane, new plantings have been started again. This accounts for the large percentage of non-bearing coffee bushes in 1934.

TABLE 4. AGE OF COFFEE BUSHES
224 COFFEE FARMS, PUERTO RICO, 1934

Age of Coffee Bushes	Cuerdas	Per cent of total
(Years)		
1—3	8,243	42
4—8	4,961	25
9—25	6,616	33
Total	19,820	100

CROP YIELDS

During 1934, the average yield of coffee per *cuerda* on the farms studied was 92 pounds (table 5). On 26 per cent of the number of farms, the yield of coffee per *cuerda* was less than 50 pounds, while on 11 per cent of the farms, it was more than 200 pounds. The highest yield obtained on any of the farms was 378 pounds, and the lowest was 12 pounds per *cuerda* of coffee. An average of 92 pounds per *cuerda* during 1934 was only from one-half to one-third of what is generally considered a satisfactory normal yield of coffee in Puerto Rico.

Sugar-cane yield on these coffee farms averaged 492 quintals per *cuerda*. This yield of sugar cane compares satisfactorily with the average for the northern coast of Puerto Rico where sugar cane is grown, but is much lower than the average for the southern coast, where a large proportion of the sugar cane is grown under irrigation.

Most of the coffee farms where tobacco was grown, were located in the municipalities of Utuado and Jayuya, two of the leading tobacco areas in Puerto Rico. The average yield of tobacco per *cuerda*, in these two municipalities is 600 and 700 pounds respectively.† On the farms surveyed, the average yield of tobacco was 450 pounds per *cuerda*, which is much lower than the average for the regions where most of these farms were located.

The average yields obtained per *cuerda* of bananas, plantains, corn, beans, and "yautías" might be considered satisfactory for these farms, in view of the fact that these minor crops are generally grown on the poorer soils, or for some other purpose besides cash crops.

The yields of the crops included in table 5 were used as a basis in the calculation of the crop index for each farm.

TABLE 5 CROP YIELDS

224 COFFEE FARMS, PUERTO RICO, 1934

Crop	Number of cuerdas harvested	Average yield per cuerda
Coffee	11,577	92 pounds
Sugar cane	102	492 quintals*
Tobacco	302	4.5 quintals
Bananas	3,070	9.2 thousands
Plantains	125	6.5 thousands
Corn	345	6.0 quintals
Beans	246	2.8 quintals
Yautías	124	22.4 quintals

* One quintal is equivalent to 100 pounds.

† F. Joglar Rodríguez, Puerto Rico Agricultural Experiment Station, Extension Bulletin No. 4, "Cultivo del Tabaco", Appendix Table 1.

CROP SALES

The total receipts from the sale of crops in the 224 coffee farms amounted to $214,723, or an average of $1,460 per farm. Of this, 65.7 per cent was solely from coffee; 10.0 per cent from bananas; 5.7 per cent from sugar cane; 5.6 per cent from tobacco; 4.8 per cent from oranges; 2.7 per cent from plantains; and 5.5 per cent from the sale of other crops (table 6).

The average farm price obtained on these farms per quintal (100 pounds) of coffee in 1934 was $21.32. The 5-year average price per exported quintal, for the 1930–1934 fiscal years, was $25.20.†

The farm price of coffee in Puerto Rico since 1928 has tended to drop in spite of the small supply, due principally to the depression and to the fact that during this period there has been heavy smuggling of cheap foreign coffee into the Island. Sugar cane and tobacco prices have also dropped during this period.

Such crops as oranges, plantains, and bananas, which are usually delivered at the farm to be sold at the local town markets, had also very low prices during 1934.

TABLE 6. CROP SALES

224 COFFEE FARMS, PUERTO RICO, 1934

Crop	Quantity sold	Total sales	Average price per unit of sale	Sales per farm	Per cent of total
Coffee	10,072*	$214,723	$21.32	$959	65.7
Sugar cane	91,147*	18,743	0.20	84	5.7
Tobacco	1,209*	18,320	15.15	82	5.6
Oranges	6,794**	15,576	2.29	69	1.8
Plantains	677**	8,924	13.18	40	2.7
Bananas (all kinds)	20,684**	32,650	1.58	146	10.0
Other crops	....	18,196	....	80	5.5
Total	....	$327,132	....	$1,460	100.0

* Quintals. ** Thousands.

LIVESTOCK

There was a wide variety of livestock on these farms, although the average value of livestock per farm was only $286. Most farmers kept some dairy cattle and work animals besides their usual small poultry flock.

† Weighted average computed from figures in the 1934 Yearbook of Statistics of the Department of Agriculture and Commerce of Puerto Rico, based on reports of the United States Customs House.

DAIRY CATTLE

Dairy cows were commonly kept on these coffee farms, mainly for the milk, which was used for home consumption. In some cases a part of the milk was sold to neighboring farmers or retailed at a near-by town.

The "native" cow was the predominant breed, in spite of its low milk production. A few Holstein, Jersey, and Guernsey grades were found on some farms.

The value of all dairy cattle kept on these farms was $133 per farm, or nearly 50 per cent of the total value of all livestock (table 7).

WORK ANIMALS

Work animals on these farms included oxen, horses, mules, and donkeys. Oxen were most numerous on those farms which grew sugar cane in addition to coffee. They were used mostly for plowing the fields and hauling the cane during harvest time.

Horses, mules, and donkeys were mostly used as pack animals for the transportation of produce from the farm to the local town markets. This method of transportation was most common on those farms where transportation facilities were poor because of the absence of suitable roads. The average value of all work animals on those farms was $113.

POULTRY

A small poultry flock was found on each of the farms surveyed. This flock was kept mainly to supply the family needs for eggs and chickens. Practically all of the birds were of the game breed, with but few cases in which Rhode Island Reds, White Leghorns, or other improved poultry breeds were kept. The total value of the poultry flock was $19 per farm.

OTHER LIVESTOCK

Swine were kept on most farms. The average value was $7 per farm. On many of the farms surveyed, swine provided the farmer and his family with most of the year's supply of lard, pork, and a wide variety of sausages and other products.

Goats and sheep are uncommon on coffee farms. Most farmers object to them because of the large amount of damage they do to crops.

Bees were very common several years ago on coffee farms in Puerto Rico. Because of the low price of honey during the past few years, most farmers have discontinued keeping bees.

The average value per head of stock was an indication of the poor quality of livestock kept on these coffee farms, and, consequently, showed the need for improvement. The average production of milk per cow during 1934 was only 530 quarts, of which 19 per cent was sold, thus leaving 429 quarts of milk for home use during the year. This amount of milk was hardly sufficient to supplement the needs of the average family on a coffee farm. By increasing the number of Holstein, Jersey, and Guernsey grades and improving the feeding practice, improvement along this line could be readily obtained.

TABLE 7. LIVESTOCK
224 COFFEE FARMS, PUERTO RICO, 1934

Type	Average per farm		Value per head of stock
	Number	Value	
DAIRY CATTLE:			
Cows	3.5	$100	$29
Heifers—1 year old or over	1.3	16	12
Heifers—under 1 year old	0.5	3	6
Calves	1.1	6	5
Bulls	0.4	8	20
Total	....	$133	....
WORK ANIMALS:			
Oxen	0 7	$24	$34
Horses	1.5	44	29
Mules	1.1	44	40
Donkeys	0.1	1	10
Total	....	$113	....
POULTRY:			
Hens	21.3	$11	$0.52
Roosters	2 7	4	1.48
Pullets	13.9	4	0.29
Other fowl	0.1	*	....
Total	....	$19	....
OTHERS:			
Swine	1.1	$7	$6
Goats and sheep	0.3	1	3
Rabbits	0.4	*	....
Bee hives	5.9	13	2
Total	....	$286	....

* Less than $1.

MISCELLANEOUS RECEIPTS

In addition to the income from the sale of crops or livestock, most farms had some miscellaneous source of income. The total income from these miscellaneous sources amounted to $23,640 in 1934, or an average of $106 per farm (table 8). Of these $106 per farm, $55 were from the sale of charcoal, which was made from the wood obtained from the pruning and topping off of the permanent shade trees. This work was usually done on a share basis with one of the hired men.

Second in importance was the income from the benefit and rental payments received from the Agricultural Adjustment Administration on those farms which also grew tobacco. The average income from this source was $28 per farm. Income from the sale of wood, fence posts, or other sources made up the balance of the miscellaneous receipts per farm. Man labor off farm was an insignificant source of income on these farms.

On the basis of the number of farms reporting, income from the Agricultural Adjustment Administration payments averaged $347 per farm; from the sale of charcoal, $126; from wood, $97; from fence posts, $85; from man labor off farm, $30; and $142 from other sources.

TABLE 8. MISCELLANEOUS RECEIPTS
224 COFFEE FARMS, PUERTO RICO, 1934

	Total	Average per farm reporting	Average per farm (all farms)
Charcoal	$12,203	$126	$55
Man labor off farm	61	30	......
Wood	2,530	97	11
Fence posts	597	85	3
A. A. A.*	6,254	347	28
Other income	1,995	142	9
Total	$23,640	....	$106

* Benefit and rental payments on the 1934 tobacco crop.

MACHINERY AND EQUIPMENT

The average value of all machinery and equipment on the farms studied was $358 per farm (table 9).

Depulping machines were the most common type of machinery found on coffee farms. Many different types of depulping machines were found on these farms, ranging from the hand machine, the overshot wheel type, and animal-power types to the gasoline engine and electric types. The value of these depulping machines was $100 per farm or $110 per machine.

The hot-air coffee drier is an expensive modern type of machine, and was found on only twelve of the farms studied.

Ox-carts were used mostly for hauling the sugar cane, although motor trucks were also being used on those farms within easy access of satisfactory roads.

All of the cultivation of the coffee bushes was done by hand. The average value of hand-cultivating equipment was not so high as would have been expected, because the hired men furnished their own equipment in most cases.

Though very little plowing is done in the coffee fields, some plows are to be found, especially in those farms growing crops other than coffee.

The almost complete absence of tractors from coffee farms was indicated by the fact that only one tractor was found on the 224 coffee farms. This particular farm had a large acreage in tobacco.

TABLE 9. MACHINERY AND EQUIPMENT

224 COFFEE FARMS, PUERTO RICO, 1934

Type	Number	Value	
		Total	Per farm (all farms)
Depulping machines	204	$22,392	$100
Motors	115	10,967	49
Bombo (hot-air coffee drier)	12	28,120	126
Trucks	11	5,515	25
Ox-carts	48	2,341	10
Horse-carts	2	34	..
Hand cultivating equipment		3,803	17
Plows	51	689	3
Harrows	7	106	......
Tractor	1	206	1
Trapiche*	1	77	......
Other	.	5,953	27
Total	. .	$80,203	$358

* Small mill for grinding sugar cane at the farm

FARM PRIVILEGES

Farm privileges include what the farmer got from his farm for his year's work besides his labor income. The yearly rental value of the farm house, plus all the farm and livestock products obtained during the year constituted the farm privileges. The value of the farm privileges for all farms studied averaged $451 during the year 1934 (table 10).

Minor produce, which included coffee, bananas, and minor crops from the farm used in the farmer's home, accounted for the major part of the privileges ($150). Next in importance was the yearly rental value of the farm house, which averaged $125. Milk was third in importance as a farm privilege, averaging $119 per farm. Other products, such as charcoal, eggs, livestock, wood, fruits, honey, lard, and sausages also constituted some of the farm privileges which these coffee farmers in Puerto Rico received.

The farm privileges, when added to the labor income, represented the labor earnings of the farmer. The average labor earnings for all of the farms studied was $-669 per farm (table 11).

TABLE 10. FARM PRIVILEGES
224 COFFEE FARMS, PUERTO RICO, 1934

	Average per farm	
	Amount	Value
Milk (quarts)	1,484	$119
Eggs (dozens)	86	16
Livestock	....	11
Minor produce	....	150
Rent value of dwelling	....	125
Charcoal	....	19
Wood	....	7
Fruits	....	2
Honey, lard, and sausages	....	2
Total	....	$451

CASH FARM EXPENSES

The average cash farm expenses for all farms was $1,336 (table 11). Of this amount, 77.2 per cent was spent for labor; 8.5 per cent for taxes; 4.6 per cent for new buildings and repairs; 3.5 per cent for fertilizer; 2.3 per cent for livestock feed; and 3.9 per cent for other cash expenses.

LABOR

Labor was the most important item of expense on these farms, most of it being for hired day labor, which averaged $870 per farm, and $890 per farm reporting. Only 5 farms out of the 224 did not hire day labor in 1934. There were three farms operated by managers. The expense for manager's salary represented 1.1 per cent of the cash farm expenses, and amounted to $1,100 per year on those farms reporting. A "mayordomo", or foreman, was employed on 88 of the coffee farms. The expense for his salary was 8.0 per cent of the cash expenses per farm, and amounted to $272 per farm reporting. Labor compensation insurance averaged $40 per farm, and $59 per farm reporting.

TAXES

Taxes were the second most important group of cash farm expenses, averaging $113 per farm. The expense for taxes represented 8.5 per cent of the cash farm expenses, and 0.73 per cent of the average farm capital per farm.

LIVESTOCK FEED

Livestock feed averaged $31 per farm, of which $22 was for poultry feed. The expense for cattle feed averaged only $6 per farm. Since there were only 19 farms reporting cattle feed expense, the average per farm reporting was $72.

MISCELLANEOUS EXPENSES

Cash expenses for fertilizer averaged $45 per farm, and $179 per farm reporting. Fertilizer was purchased on 56 of the farms surveyed, but on only 17 of these farms it was applied to the coffee bushes. On the other farms it was applied either to sugar cane or to tobacco.

TABLE 11. CASH FARM EXPENSES
224 COFFEE FARMS, PUERTO RICO, 1934

	Total expense	Average per farm reporting	Average per farm (all farms)	Per cent of total
	Dollars	Dollars	Dollars	
LABOR:				
Manager's salary	3,300	1,100	15	1.1
Mayordomo's salary	23,973	272	107	8.0
Hired day labor	194,844	890	870	65.1
Labor compensation insurance	8,948	59	40	3.0
Total	231,065	....	1,032	77.2
TAXES:				
Property tax	23,607	105	105	7.9
Coffee insurance tax	1,536	24	7	0.5
Tobacco protection tax	287	16	1	0.1
Total	25,430	....	113	8.5
LIVESTOCK FEED:				
Cattle	1,377	72	6	0 4
Poultry	4,848	36	22	1.7
Other animal feed	719	90	3	0.2
Total	6,944	....	31	2.3
Fertilizer	10,035	179	45	3.5
Insecticides	328	25	2	0.1
BUILDINGS:				
New	5,909	311	26	1.9
Repairs	7,798	134	35	2.7
Total	13,707	....	61	4.6
Equipment:				
Purchased	531	59	2	0.1
Repairs	309	26	1	0.1
Total	840	....	3	0 2
Transportation of produce	3,774	22	17	1.4
Hired animals	124	31	1	0.1
Shoeing horses	612	6	3	0.2
Seed purchased	1,529	27	7	0.5
Fences	1,824	27	8	0.6
Farm share auto	556	111	2	0.1
Truck	885	177	4	0.3
Bags	760	7	3	0.2
Toldas*	465	9	2	0.1
Gas and oil for depulping machine	481	5	2	0 1
Total	299,359	....	1,336	100.0

* Burlap for drying coffee.

The expense for construction and repair of buildings averaged $61 per farm. New buildings were constructed on 19 farms at an average cost of $311.

Equipment costs were relatively insignificant on the 224 coffee farms. Of the other cash farm expenses, the most important was

that for the transportation of produce, which averaged $17 per farm, or 1.4 per cent of the cash farm expenses. Because of the fact that many farms lacked suitable roads, the transportation of the farm produce to the local market was slow and expensive. Such expenses as purchase of seed, bags, "toldas", and gas and oil for the depulping machine, although common, were of minor importance.

LABOR INCOME

Labor income is one of the most generally accepted measures of the business success of a farm. It represents what the farmer received for his year's work and management, in addition to having a house to live in and products furnished by the farm, after allowing a reasonable amount of interests on his capital invested in the farm business. It is comparable to the cash wages of a married hired man on a farm, who also receives the use of a house and farm products.

The average total receipts per farm was $1,633, most of which was derived from the sale of crops, especially coffee (table 11). The average total expenses per farm was $1,506. The value of the unpaid family labor as estimated by the farmer was included as an expense, since that would have been the approximate cost of hiring the work done. The increase in farm capital during the year was not enough to balance the decrease, resulting in a net decrease in farm capital, which was also charged as an expense.

The average total receipts exceeded the average total expenses on these farms by $127. This was the farm income, or the amount which the operator received for his year's work and for the use of the capital invested. In order to put all farms on a comparable basis, regardless of mortgage indebtedness, 8 per cent interest on the average capital invested was deducted from the farm income to obtain the labor income.

The average labor income on these 224 farms was $-1,120 per farm. This means that, on the average, these farmers failed by $1,120 to meet their total farm expenses and interest on investment, and received nothing for their year's work.

A farmer's labor income might be nothing, or even less than nothing, as in this case, and yet he might be making a living. If the farm income were $500 and the capital invested were $10,000, the labor income would be $500 less 8 per cent on the $10,000 capital ($800), or minus $300. However, if he had no mortgage nor any other debt, the farmer would have $500 to live on. If he had had a son working at the farm who was not paid wages, but whose time

was included in the expenses as $200, the family would then have had $700 to live on. The farmer might thus be living well, in spite of having a negative labor income.

Labor earnings is the labor income plus the value of the farm privileges. The average value of farm privileges per farm (table 10) was $451, which, when added to the labor income, resulted in an average labor earnings of $-669 per farm.

The return on capital is calculated by subtracting the value of the operator's time, as estimated by the farmer, from the farm income. The farm income, as already stated, represents the amount the operator received for his year's work and the use of his farm capital. By subtracting the estimated value of the operator's time from the farm income, the return on his capital invested is obtained. The average return on capital for these farms was $-377.

TABLE 12. LABOR INCOME SUMMARY

224 COFFEE FARMS, PUERTO RICO, 1934

	Total	Average per farm
RECEIPTS:		
Crops sold	$327, 132	$1, 460
Livestock sold	3, 973	18
Livestock products sold	10, 891	49
Miscellaneous	23, 640	106
Total	$365, 636	$1, 633
EXPENSES:		
Cash farm expense	$299, 359	$1, 336
Livestock purchased	2, 026	9
Unpaid labor	20, 659	92
Net decrease in farm capital	15, 296	69
Total	$337, 340	$1, 506
Farm income	28, 296	127
Less: 8 per cent interest on average farm capital	279, 207	1, 247
Labor Income:	**$-250,911**	**$-1,120**
Labor earnings	-149, 904	-669
Return on capital	-84, 528	-377
Per cent return on capital	-2 42	-2 42
Value of operator's time	112, 824	504
Capital turnover	.	9 54

The per cent return on capital is the return on capital expressed as a percentage of the average farm capital. These farmers had an average of $15,580 invested in their farm businesses. The return on this capital averaged minus $377, or minus 2.42 per cent of the capital.

Capital turnover is the number of years required for receipts to equal capital. An average of 9.54 years, as obtained for these coffee farms, indicates a very slow capital turnover during 1934.

TOTAL CUERDAS IN COFFEE AND LABOR INCOME

Total *cuerdas* in bearing and non-bearing coffee was a satisfactory measure of size of business in the farms studied. The farms were divided into five different groups, according to total *cuerdas* in coffee per farm. In each of these groups the average labor income obtained was a negative figure, indicating a loss (table 13).

The group containing the smallest farms has 16 *cuerdas* in coffee, and made a labor income of $-344. The second group, with 49 *cuerdas* in coffee, made a labor income of $-663. In the third group there were 96 *cuerdas* in coffee, and the labor income was $-1,264. The fourth group had 149 *cuerdas* in coffee and averaged $-1,656 labor income. The group with the largest farms had 274 *cuerdas* in coffee, and made a labor income of $-3,180. The relation between total *cuerdas* in coffee and labor income indicated that the greater the number of *cuerdas* in coffee, the larger was the loss.

Size of business may have a direct or an indirect relationship to labor income, depending on whether the crop year was good or poor. There were many conditions that made 1934 a poor crop year for coffee farmers in Puerto Rico: low yields of coffee were obtained; a large percentage of the coffee bushes was not yet bearing; and prices for coffee had also dropped. Under such conditions the larger farms would be expected to lose more money than the smaller farms.

Other measures of size of business, such as total *cuerdas* per farm, capital invested, and gross receipts, had the same relation to labor income as did total *cuerdas* in coffee. The larger the size of the farm business, as measured by each of these other factors, the greater the loss, as indicated by the labor incomes. Mortgage debts per farm, both Federal Land Bank and Hurricane Relief Commission mortgages, increased together with size of farm.

Yield and crop index did not show the same relationship to labor income with increasing acreage in coffee as did the measures of size of business. There was a curvilinear relationship, indicating that high yields could be obtained on small farms as well as on large farms.

As the total *cuerdas* in coffee increased the per cent income from coffee also increased, indicating that the larger farms had less diversification and were thus more dependent on sales of coffee for their income.

TABLE 13. RELATION OF TOTAL CUERDAS IN COFFEE TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

	Total cuerdas in coffee					Average for all farms
	Less than 30	30–79	80–129	130–179	180 or more	
Number of farms	63	71	36	23	31	224
Cuerdas in coffee:						
Bearing	10	31	51	93	154	52
Non-bearing	6	18	45	56	120	37
Total	16	49	96	149	274	89
Labor income	$-344	$-363	$-1,264	$-1,656	$-3,180	$-1,120
Farm income	$52	$78	$-143	$364	$526	$127
SIZE FACTORS:						
Size of farm (cuerdas)	59	114	203	300	489	186
Total cuerdas in crops	27	72	124	196	333	117
Net cuerdas in crops	20	55	101	157	290	96
Capital invested	$4,945	$9,265	$14,008	$25,250	$46,320	$15,580
Gross receipts	$545	$1,037	$1,439	$2,915	$4,764	$1,633
Receipts from coffee sales	$185	$516	$750	$1,767	$3,218	$963
Federal Land Bank mortgage	$1,675	$2,542	$3,639	$7,630	$9,168	$3,955
Hurricane Relief Commission mortgage	$944	$2,190	$3,861	$6,022	$8,855	$3,424
Man equivalent	3.0	4.8	8.0	12.2	19.4	7.5
EFFICIENCY FACTORS:						
Yield of coffee per cuerda (pounds)	112	96	84	97	107	92
Crop index	120	98	94	106	110	100
Gross returns per cuerda	$12	$10	$8	$10	$10	$10
Cuerdas in crops per man equivalent	7.5	13.2	15.2	15.5	17.5	12.7
Coffee sales per man equivalent	$62	$108	$94	$145	$166	$76
Per cent income from coffee	50	56	59	65	74	58

TOTAL CUERDAS PER FARM AND LABOR INCOME

There were 42 farms of less than 50 *cuerdas* in size. The average labor income for this group of farms was $-230. These farms had 15 *cuerdas* in coffee, and their average farm capital was $3,069 (table 14).

The second group consisted of 82 farms, averaging 90 *cuerdas* per farm, and with a labor income of $-718. This group had 48 *cuerdas* in coffee and $8,552 in capital.

In the last group are included 31 farms whose size was 350 *cuerdas* or more. The average size of farm in this group was 547 *cuerdas,* and their labor income $-2,868. They had 245 *cuerdas* in coffee and a capital of $43,805.

The relation existing between total *cuerdas* per farm and labor income indicated that as the size of farm increased the acreage in coffee, capital invested, and *cuerdas* in crops per man equivalent also increased, but the labor income decreased. This relation points again to the fact that, during 1934, the larger farms lost more money than did the smaller farms.

TABLE 14. RELATION OF SIZE OF FARM TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Size of farm (cuerdas)		Number of farms	Total cuerdas in coffee	Capital invested	Cuerdas in crops per man equivalent	Labor income
Range	Average					
Less than 50	27	42	15	$3,069	7.1	$-230
50–149	90	82	18	8,552	13.1	718
150–249	199	47	95	16,221	13.9	-1,134
250–349	291	22	146	24,532	11.7	1,718
350 or more	517	31	245	13,805	16.0	-2,868

CUERDAS IN BEARING COFFEE AND LABOR INCOME

The number of *cuerdas* in bearing coffee was a good measure of size of business. On these 224 coffee farms it showed the same relationship to labor income as did the other measures of size (table 15).

The first group consisted of 106 farms averaging 14 *cuerdas* of bearing coffee per farm, and a man equivalent of 4.1. Fifty per cent of their total income was from the sale of coffee. The average farm income for this group of farms was $-21, and the labor income $-556.

In contrast with these small farms the 20 largest farms had an average of 194 *cuerdas* in bearing coffee and a man equivalent of 18.6. About three-fourths of the receipts on these farms were from the sale of coffee. These farmers made $793, besides paying all their farm expenses. Their labor incomes, however, were much lower than those for the first group of farms. They averaged $-3,181. This was due to the fact that the large farms had a much greater investment in capital. The farm income on these farms was not large enough to allow for the 8 per cent interest deduction, and, consequently, a large negative labor income resulted. If all the farms had been completely out of debt, the larger farms would have been much better off than the smaller farms, since they made approximately $800 above expenses.

TABLE 15. RELATION OF CUERDAS IN BEARING COFFEE TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Cuerdas in bearing coffee		Number of farms	Man equivalent	Per cent income from coffee	Farm income	Labor income
Range	Average					
Less than 30	14	106	4.1	50	$-21	$-556
30–79	51	74	7.1	62	100	-1,061
80–129	103	24	15.5	71	303	-2,078
130 or more	194	20	18.6	73	793	-3,181

NET CUERDAS IN CROPS AND LABOR INCOME

An indirect relationship was observed between net *cuerdas* in crops and labor income. Labor income decreased as the average number of net *cuerdas* in crops in each group of farms increased (table 16).

The smaller farms with 27 net *cuerdas* in crops, including 24 in coffee, had an average capital of $5,773. The yield obtained was 108 pounds of coffee per *cuerda,* and the labor income $-424. Fifty-four per cent of the gross income on these farms was from the sale of coffee. Labor costs averaged $11 per *cuerda* in crops, and there were 9.1 *cuerdas* in crops per man equivalent.

The large farms averaged 294 net *cuerdas* in crops, 274 *cuerdas* in coffee, and had a capital of $47,017. The yield of coffee was 106 pounds per *cuerda,* and the labor income $-3,119. Seventy-one per cent of the income was from coffee sales. Labor costs averaged $10, and there were 17.1 *cuerdas* in crops per man equivalent.

Yield of coffee per *cuerda* was low for each group of farms in general. There was no relation between net *cuerdas* in crops and yield of coffee per *cuerda.*

As the net *cuerdas* in crops increased, the per cent income from coffee also increased, indicating that the larger farms were more dependent on coffee for their income. Labor costs per *cuerda* in crops tended to remain fairly constant as the size of farm business increased.

TABLE 16. RELATION OF NET CUERDAS IN CROPS TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Net cuerdas in crops		Number of farms	Total cuerdas in coffee	Capital invested	Yield of coffee per cuerda (*Pounds*)	Per cent income from coffee	Cuerdas in crops per man equivalent	Labor costs per cuerda in crops	Labor income
Range	Average								
Less than 50	27	96	24	$5,773	108	54	9.1	$11	$-424
50-99	73	55	67	11,593	86	56	15.0	10	-920
100-149	118	25	111	17,686	99	59	15.0	12	1,382
150-199	167	18	158	24,728	105	68	15.3	11	-1,750
200 or more	294	30	274	47,017	106	71	17.1	10	-3,119

CAPITAL INVESTED AND LABOR INCOME

There was a marked relationship between the amount of capital invested and the labor income on the farms studied. The larger the capital invested, the greater the loss (table 17).

The first group of farms, with an average capital of $2,959, had a total area of 40 *cuerdas,* 20 of which were in coffee. The gross receipts for this first group of farms averaged $373, of which $161 was from the sale of coffee. This group of farms had an average labor income of $-267.

The last group of farms had an average capital of $44,224 and 447 *cuerdas* per farm, with 237 *cuerdas* in coffee. Gross receipts amounted to $4,569 per farm, including $2,955 from the sale of coffee. This group had an average labor income of $-2,894.

Considering the facts that coffee yields in 1934 were unusually low and that most of the farmers actually lost money in their businesses, it was reasonable to expect that the larger the amount of capital invested in the farm business, the greater would be the loss.

The amounts of Federal Land Bank mortgages, as well as those of the Hurricane Relief Commission increased, together with capital invested. However, when the mortgage indebtedness from these two sources was expressed as a percentage of the farm capital, the larger farms had 40 per cent, while the smaller farms had approximately 60 per cent. The average mortgage debt held by these two agencies on the 224 coffee farms was 47 per cent of the farm capital.

TABLE 17. RELATION OF CAPITAL INVESTED TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Capital invested (dollars)		Number of farms	Size of farm (*cuerdas*)	Total cuerdas in coffee	Gross receipts	Coffee sales	Federal Land Bank mortgages	Hurricane Relief Commission mortgages	Labor income
Range*	Average								
Less than 5,000	$2,959	55	40	20	$373	$161	$1,082	$700	$-267
5,000— 9,999	7,450	57	110	46	964	443	2,237	1,974	-575
10,000—14,999	12,047	36	169	76	1,193	744	3,389	2,806	-978
15,000—24,999	19,912	37	251	111	2,107	1,069	5,635	5,851	-1,496
25,000 or more	44,424	39	447	237	4,569	2,955	9,419	7,654	-2,894
Average (all farms)	15,580	224	186	89	1,633	963	3,955	3,424	-1,120

GROSS RECEIPTS AND LABOR INCOME

The relation between gross receipts and labor income was also indirect. There were 61 farms with gross receipts of less than $500, averaging $258 per farm (table 18). These farms had 30 *cuerdas* in coffee, and a crop index of 91. They were short by $176 in meeting their total farm expenses, and their average labor income was $-596.

Gross receipts of $2,000 or more were obtained in 49 farms. The average was $4,779 per farm. This group of farms had 193 *cuerdas* in coffee and a crop index of 139. After paying all the farm expenses, these farmers made $1,033; but even then their labor income was $-1,849. If these farms had had no mortgage indebtedness, the farmers would have had an income of $1,033 to live on, and, consequently, would have been much better off than those farmers in the first group of farms.

Total *cuerdas* in coffee and crop index were closely associated with gross receipts. Both varied directly with gross receipts, and were causal factors in determining the amount of gross receipts per farm.

TABLE 18. RELATION OF GROSS RECEIPTS TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Gross receipts (dollars)		Number of farms	Total cuerdas in coffee	Crop index	Yield of coffee per cuerda (*Pounds*)	Coffee sales	Animal units	Farm income	Labor income
Range	Average								
Less than 500	258	61	30	91	74	163	3.0	$-173	$-596
500-999	713	52	51	96	90	371	5.1	-192	-830
1,000-1,499	1,233	42	87	103	103	600	8.7	-91	-1,180
1,500-1,999.	1,791	20	112	105	103	1,005	10.9	-121	-1,563
2,000 or more	4,779	49	193	139	137	2,893	21.2	1,033	-1,849

MAN EQUIVALENT AND LABOR INCOME

The relation between man equivalent and labor income was the same as that for other measures of size of business already discussed. The larger the man equivalent in any group of farms, the smaller the labor income (table 19).

Fifty of the farms studied had less than 3.0 man per farm. The average labor income on these farms was $-281. There were 54 *cuerdas* per farm, 22 of which were in coffee. Crop index averaged 101; *cuerdas* in crops per man equivalent, 11.9; labor costs per *cuerda* in crops, $7; and coffee sales per man equivalent, $84.

In contrast with this group of small farms, the 40 largest farms had an average of 20.0 man, and a labor income of $-2,714. These farms had 10 times as many *cuerdas* in coffee as the small farms; the crop index was only about 20 per cent higher; *cuerdas* in crops per man equivalent were practically the same; and labor costs per *cuerda* in crops doubled. Labor costs per *cuerda* in crops showed a direct relationship to man equivalent. However, this increased cost of labor did not produce an increased efficiency in the use of labor,

since there was no relation between crop index or *cuerdas* in crops per man equivalent and number of men per farm.

Coffee sales per man equivalent increased steadily from $84 in the small farms to $149 in the large farms. This direct relationship was partly due to the fact that the larger farms were more dependent on coffee for their income.

TABLE 19. RELATION OF MAN EQUIVALENT TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Man Equivalent		Number of farms	Size of farm (*Cuerdas*)	Total cuerdas in coffee	Crop index	Cuerdas in crops per man equivalent	Labor costs per cuerda in crops	Coffee sales per man equivalent	Labor income
Range	Average								
Less than 3.0	2.1	50	54	22	101	11.9	$7	$84	$-281
3.0–5.9	4.4	84	112	49	105	12.3	11	104	-697
6.0–8.9	7.4	29	203	99	95	14.7	11	107	-1,328
9.0–11.9	10.2	21	256	134	105	14.5	12	124	-1,487
12.0 or more	20.0	40	447	225	122	12.4	14	149	-2,714

GROSS RETURNS PER CUERDA AND LABOR INCOME

The relation between gross returns per *cuerda* and labor income showed that, in general, the larger the gross returns per *cuerda*, the smaller the losses. This relation was true particularly on those farms with gross returns of more than $5 per *cuerda* (table 20).

Of the 224 coffee farms, 58 had a gross return per *cuerda* of less than $5. They made a farm income of $-316 and a labor income of $-1,269. This group of farms had an average of 74 *cuerdas* in coffee, a crop index of 70, and 14.2 *cuerdas* in crops per man equivalent.

The second group consisted of 82 farms, with an average of $7 gross returns per *cuerda,* a farm income of $-125, and a labor income of $-1,455. The labor income for this group of farms decreased in spite of the higher gross returns per *cuerda,* crop index, acreage in coffee, and farm income obtained; thus indicating that these farms were over-capitalized.

The group of farms with the largest gross returns per *cuerda* averaged $29. The farm income was $1,085, and the labor income was $-109. The crop index for this group was 2.3 times as large as that of the first group. These farms had 8.3 *cuerdas* in crops per man equivalent.

This table showed that gross returns per *cuerda* were directly associated with crop index and farm income; indirectly associated with *cuerdas* in crops per man equivalent and labor income; and had no definite relationship to total *cuerdas* in coffee.

TABLE 20. RELATION OF GROSS RETURNS PER CUERDA TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Gross returns per cuerda (Dollars)		Number of farms	Crop index	Total cuerdas in coffee	Cuerdas in crops per man equivalent	Farm income	Labor income
Range	Average						
Less than 5...	3	58	70	74	14.2	$-316	$-1,269
5-9 .	7	82	97	103	14.1	-125	-1,455
10-14 ..	11	39	126	97	11.9	415	-1,019
15-19	17	19	132	86	10.3	656	-811
20 or more	29	26	161	63	8.3	1,085	-109

CROP INDEX AND LABOR INCOME

Crop index was directly associated with labor income. As the average crop index in each of the five groups of farms increased from 40 to 254, the average labor income also increased from $-1,486 to $-113 (table 21). In other words, the group of farms having an average crop index of 40 lost approximately 13 times as much money as the group of farms with an average crop index of 254.

Cuerdas in bearing coffee had no direct relationship to crop index. The relation appeared to be curvilinear, showing that the first group of farms which had the largest number of *cuerdas* in bearing coffee had the lowest crop index; while the last group of farms, with practically the same acreage in bearing coffee, had the highest crop index.

Man equivalent increased together with crop index, while *cuerdas* in crops per man equivalent decreased. This indicated that, as crop index increased, more labor was required to harvest a *cuerda* of coffee. Consequently, a man could not be able to harvest as many *cuerdas* of coffee as when the crop index was low.

Yield of coffee per *cuerda* also increased together with the crop index. Since the crop index itself was heavily weighted by the yield of coffee, their magnitudes were in all cases very similar.

Gross returns per *cuerda* increased from $7 in the first group to $24 in the last group of farms. Labor costs per *cuerda* in crops increased from $8 to $16 in the first and last group respectively. Coffee sales per man equivalent averaged $64 in the first group of

farms, and increased to $273 in the last group. The farm income had also a direct relationship to crop index, increasing from $-40 to $1,759.

In general, a higher crop index implied the employment of more men and increased labor costs per *cuerda* in crops. The increasing yields and the more intensive cultivation involved reduced the number of *cuerdas* in crops per man equivalent, but increased the gross returns per *cuerda* and the coffee sales per man equivalent, thus offsetting the higher labor costs. This resulted in an increase in the farm income and labor income.

The statement that crop yields, especially of coffee, were low during 1934 is again supplemented by the fact that even those farms with a crop index 2.54 times the average crop index for all farms were not able to make a positive labor income.

TABLE 21. RELATION OF CROP INDEX TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Crop index		Number of farms	Cuerdas in bearing coffee	Man equivalent	Cuerdas in crops per man equivalent	Yield of coffee per cuerda (*pounds*)	Gross returns per cuerda	Labor costs per cuerda in crops	Coffee sales per man equivalent	Farm income	**Labor income**
Range	Average										
Less than 50	40	40	60	5.9	16.8	39	$7	$8	$61	$-401	**$-1,486**
50—99.	76	86	58	7.1	13.6	66	8	10	110	-84	**-1,242**
100—149.	124	50	39	8.3	10.5	120	11	12	103	308	**-1,024**
150—199.	169	33	40	8.3	10.9	173	11	13	158	294	**-964**
200 or more.	254	15	59	11.0	9.0	236	21	16	273	1,759	**-113**

YIELD OF COFFEE PER CUERDA AND LABOR INCOME

There was a direct relationship between yield of coffee per *cuerda* and labor income, especially on those farms with yields of more than 50 pounds of coffee per *cuerda* (table 22).

The yield of coffee per *cuerda*, on most of the farms studied, was considerably lower than what is generally considered a satisfactory yield of coffee in Puerto Rico. Fifty-eight farms had yields of less than 50 pounds of coffee per *cuerda*, averaging 32 pounds. On these farms the farm income was $-194, and the labor income $-1,180. These farms averaged 144 *cuerdas* in size, 55 of which were in bearing coffee. The crop index was 58, gros returns per *cuerda* $6, and coffee sales per man equivalent $62.

The second group included 76 farms with an average yield of 69 pounds per *cuerda*. On this group, the farm income increased to

$-79, but the labor income decreased, instead of increasing, to $-1,385. This decrease in the labor income, in spite of the increase in yield, *cuerdas* in bearing coffee, crop index, gross returns per *cuerda,* coffee sales per man equivalent and farm income, was due to the fact that the average capital invested on these farms was too large compared to that of the preceding group. The increase in farm income was not enough to cover the interest charge on this large capital, and, consequently, the labor income decreased.

There were 24 farms with an average yield of 255 pounds of coffee per *cuerda,* which represented 2.8 times the average yield for all farms. These farms made a farm income of $886, but were not able to make a positive labor income. The fact that the yield of coffee per *cuerda* in the farms studied was very low during 1934 was thus observed again.

Size of farm business, measured either by total *cuerdas* in farm, *cuerdas* in bearing coffee, or capital invested, did not show any relation to yield of coffee per *cuerda.*

TABLE 22. RELATION OF YIELD OF COFFEE PER CUERDA TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Yield of coffee per cuerda (pounds)		Number of farms	Size of farm *cuerdas*	Cuerdas in bearing coffee	Capital invested	Crop index	Gross returns per cuerda	Coffee sales per man equivalent	Farm income	Labor income
Range	Average									
Less than 50	32	58	144	55	$12,322	58	$6	$62	$-191	**$-1,180**
50—99	69	76	197	61	16,321	82	9	108	-79	**-1,385**
100—149	123	42	199	38	16,195	126	10	117	148	**-1,148**
150-199	168	24	245	54	20,108	162	12	179	760	**-846**
200 or more	255	24	153	31	15,520	206	20	240	886	**-356**

LABOR COSTS PER CUERDA IN CROPS AND LABOR INCOME

On 27 of the farms studied, the labor costs were less than $5 per *cuerda* in crops; there were 30 *cuerdas* in coffee; and the labor income was $-615 (table 23).

Sixty-one farms had labor costs of $10 to $14 per *cuerda* in crops; 103 *cuerdas* in coffee; and made a labor income of $-1,456. On 20 farms, with average labor costs of $26 per *cuerda* in crops and 42 *cuerdas* in coffee, the labor income was $-1,066. This showed that labor costs per *cuerda* in crops had a curvilinear relationship to total *cuerdas* in coffee and to labor income.

Crop index and gross returns per *cuerda* were much higher for the last two groups of farms than for the first three. These two factors caused the curvilinear relationship stated above.

Cuerdas in crops per man equivalent had an indirect relation to labor costs per *cuerda* in crops. This indicated that with higher labor costs, the coffee farms were more intensively cultivated.

TABLE 23. RELATION OF LABOR COSTS PER CUERDA IN CROPS TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Labor costs per cuerda in crops (dollars)		Number of farms	Total cuerdas in coffee	Crop index	Yield of coffee per cuerda (pounds)	Cuerdas in crops per man equivalent	Gross returns per cuerda	Coffee sales per man equivalent	Labor income
Range	Average								
Less than 5	3	27	30	63	52	18.2	$5	$81	$-615
5-9	7	88	98	102	93	15.7	10	118	-1,024
10-14	12	61	103	104	103	10.8	8	108	-1,456
15-19	17	28	98	145	141	8.0	14	165	-1,216
20 or more	26	20	42	133	134	5.1	18	78	-1,066

PER CENT INCOME FROM COFFEE AND LABOR INCOME

The relation between per cent income from coffee and labor income showed that, in general, the larger the per cent income from coffee, the smaller the labor income (table 24). This relation was constant throughout the table, except in the last group of farms. The labor income on this last group increased instead of decreasing, as compared to that of the preceding group.

The last group of farms consisted of 41 farms, with an average of 95 per cent of their income being from coffee. The increase in labor income was due to a much larger crop index, yield of coffee, and coffee sales per man equivalent, over the preceding group of farms. Gross returns per *cuerda* and *cuerdas* in coffee were also somewhat larger. The farm income, which had been decreasing, also showed a decided increase in this last group.

TABLE 24. RELATION OF PER CENT INCOME FROM COFFEE TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Per cent income from coffee		Number of farms	Total cuerdas in coffee	Crop index	Yield of coffee per cuerda (pounds)	Gross returns per cuerda	Coffee sales per man equivalent	Farm income	Labor income
Range	Average								
Less than 30	15	44	52	104	82	$13	$44	$378	$-570
30-59	46	63	82	103	96	11	110	270	-946
60-89	75	73	101	93	94	8	127	-218	-1,575
90 or more	95	41	110	135	133	10	210	240	-1,180

USE OF FERTILIZER ON COFFEE AND LABOR INCOME

Only 17 of the 224 farms studied applied any kind of commercial fertilizer to the coffee bushes (table 25). This limited number of farms using fertilizer was too small to attempt any grouping based on quantity of fertilizer applied per *cuerda*.

Those farms using some fertilizer on coffee made an average labor income of $-796, which was $351 higher than that for the farms using no fertilizer. The farm income increased $446; yield of coffee per *cuerda* was 21 per cent higher; and the crop index showed a 28 per cent increase. Gross returns per *cuerda* were 70 per cent higher, in spite of the larger size of the farms in this group.

The increases noted above are not to be attributed solely to the application of fertilizer, since the number of farms reporting such applications was very small, and the cost of such fertilizer averaged only approximately $3 per *cuerda*. There were other factors also responsible for these increases. About one-third of the farms using fertilizer on coffee had other important cash crops, such as sugar cane, tobacco, or plantains, on which fertilizer was also used.

TABLE 25. RELATION OF USE OF FERTILIZER ON COFFEE TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Factor	Farms using no fertilizer on coffee	Farms using some fertilizer on coffee
Number of farms	207	17
Labor income	$-1,147	$-796
Farm income	$92	$538
Yield of coffee per cuerda (pounds)	99	120
Crop index	104	133
Gross returns per cuerda	$10	$17
Size of farm (cuerdas)	180	235

RELATION OF SIZE OF FARM AND TYPE OF MANAGEMENT TO LABOR INCOME

The majority of the farms included in this study were operated by the owners themselves. However, when, for some reason or other, the owner was not able to live on his farm, or when the farm business was too big for him to attend alone, he usually hired a "mayordomo", or foreman. A *mayordomo* is a skilled laborer who has had experience in coffee farming and who is given a house to live in and farm privileges besides his regular wage. Usually he is well acquainted with the farm, and is in a position to run the farm business successfully. Some of these *mayordomos* had actually been owners of coffee farms themselves. Only three of the farms studied were operated by managers (table 26).

For the purpose of this analysis, the farms were divided into two groups: those of less than 200 *cuerdas* and those of 200 or more *cuerdas* in size. In each of these groups the farms operated by the owners made higher labor incomes than those operated either by the owner and a *mayordomo* or by a manager.

The average labor income on the smaller farms was $-445, when operated by the owner, and $-1,058, when operated by owner and *mayordomo*. The owner-*mayordomo* operated farms had twice as many *cuerdas* in coffee and nearly twice as much capital invested, but the crop index and gross returns per *cuerda* were lower than those on the owner-operated farms.

The large farms operated by the owners made a labor income of $-1,760. Those operated by the owner and a *mayordomo* made $-2,211, while the farms operated by managers made a labor income of $-3,825. Crop index, yield, and gross returns per *cuerda* were highest on this last group of farms, but yet they had the largest loss. This was due mostly to the large capital investment and increased cost of labor.

When the farms were operated by the owners they were able to make $85 above expenses on the small farms and $259 on the large farms. In both cases the labor income was a negative figure, the larger farms losing about 4 times as much money as the small farms.

Small farms operated by the owner and a *mayordomo* lacked $167 to meet expenses, and made a labor income of $-1,058. In contrast, the large farms operated by the owner and a *mayordomo* made $376 above expenses; but their labor income was $-2,211.

None of the small farms was operated by a manager. The three large farms under this type of management had a farm income of $-181 and a labor income of $-3,825.

TABLE 26. RELATION OF SIZE OF FARMS UNDER DIFFERENT TYPES OF MANAGEMENT TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Size of farm (cuerdas)	Average size of farm (cuerdas)	Number of farms	Total cuerdas in coffee	Gross returns per cuerda	Capital invested	Crop index	Yield of coffee per cuerda (pounds)	Farm income	Labor income
LESS THAN 200									
Operated by the owner	75	112	35	$11	$6,622	107	97	$85	$-445
Operated by owner and mayordomo	115	34	70	10	11,138	100	98	-167	-1,058
200 OR OVER									
Operated by the owner	360	27	139	7	25,228	100	96	258	-1,760
Operated by owner and mayordomo	373	48	190	9	32,338	108	107	376	-2,211
Operated by a manager	423	3	242	15	45,550	157	166	-181	-3,825

EFFECT OF SIZE OF FARM AND LOCATION ON LABOR INCOME

The location of a farm is an important factor in most types of farm businesses. A farm located near a highway generally has considerable advantages over a farm located on a dirt road, chiefly because of the easy access to the farm and to near-by markets provided by the highway.

Of the farms of less than 200 *cuerdas* in size, 72 were located on highways, 27 on dirt roads, and 47 were off the road (table 27). The average capital invested in these farms was very much the same. The main differences between these small farms were in the gross returns per *cuerda*, crop index, farm income, and labor income. The farms on dirt roads had the highest labor income ($–365), while those on the highways had the lowest ($–658).

TABLE 27. RELATION OF SIZE OF FARM AND LOCATION TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1931

Size of farm (cuerdas)	Average size of farm (cuerdas)	Number of farms	Total cuerdas in coffee	Gross returns per cuerda (dollars)	Capital invested (dollars)	Crop index	Farm income (dollars)	Labor income (dollars)
LESS THAN 200								
On highway	78	72	41	11	7,781	97	–36	–658
On dirt roads	77	27	33	14	6,894	122	187	–365
Off road	98	47	51	9	7,959	108	30	–607
200 OR OVER								
On highway	359	31	161	7	29,492	90	–48	–2,407
On dirt roads	505	12	239	15	47,575	106	2,054	–1,752
Off road	335	35	163	8	25,281	102	37	–1,985

Of the farms of 200 or more *cuerdas* in size, 31 were on highways, 12 on dirt roads, and 35 off the road. The farms on dirt roads had again the highest labor income ($–1,752), while those on highways were again lowest ($–2,407). The dirt-road farms differed considerably from the other farms. Their size and number of *cuerdas* in coffee was much larger than for the other groups. The crop index was also higher, and the gross returns per *cuerda* about twice that of the other groups. These four factors, together, were directly responsible for the very high farm income ($2,054) in this group of farms. However, although this farm income appeared to be high, it was not sufficient to cover an 8 per cent interest on the average capital of $47,575, and thus a negative labor income resulted.

In general, this table indicated that, contrary to what would have been the general expectation, the best coffee farms, of those studied,

were not to be found along the highways. The only explanation with respect to this point is the fact that the highways are usually located along the lower sections of the coffee region in Puerto Rico, where the temperature and probably the soils are not so well adapted to coffee as they are in the higher sections. This accounted in part for the low crop indices obtained on the highway farms. The dirt-road farms had, in both cases, the highest crop indices.

EFFECT OF TOTAL CUERDAS IN COFFEE AND CROP INDEX ON LABOR INCOME

The relation between total *cuerdas* in coffee and labor income was already discussed in table 13. The object of table 28, however, was to show how this relation between total *cuerdas* in coffee and labor income was affected by different crop indices. For this purpose the farms were classified, on the basis of crop index, into three major groups: less than 75, 75 to 149, and 150 or more. Each of these groups was in turn sub-divided, according to total *cuerdas* in coffee into three minor groups: less than 50 *cuerdas*, 50 to 99, and 100 or more.

On each of the three major groups the labor income decreased, regardless of crop index, as the total *cuerdas* in coffee *increased*. This same relationship was observed in table 13. When the crop index was taken into consideration it was observed that labor income increased as the crop index for each minor group of farms increased. The larger farms, however, did not show this relationship so closely.

The group of small farms with a low crop index had an average labor income of \$–530. That, with a medium crop index, increased its labor income to \$–450. With a high crop index, the labor income was further increased to \$–233.

The medium-sized farms showed a similar relationship. Those with a low crop index had an average labor income of \$–1,120; with a medium crop index, it increased to \$–998; and with a high crop index, the labor income again increased to \$–333.

Large farms, with a low crop index, made a labor income of \$–2,319. On those with a medium crop index the labor income decreased to \$–2,504. With a high crop index, however, the labor income for the large farms increased considerably to \$–1,666. This large increase indicated that the general tendency was for the large farms to show the same relationship as did the small and medium farms. Due to some reason, the second group of large farms failed to show such relationship.

TABLE 28. TOTAL CUERDAS IN COFFEE AND CROP INDEX IN RELATION TO LABOR INCOME AND OTHER FACTORS

224 COFFEE FARMS, PUERTO RICO, 1934

Total cuerdas in coffee	Number of farms	Average cuerdas in coffee	Average crop index	Gross returns per cuerda (dollars)	Yield of coffee per cuerda (pounds)	Cuerdas in crops per man equivalent	Labor income (dollars)
FARMS WITH A CROP INDEX OF LESS THAN 75:							
Less than 50 cuerdas.	29	30	47	7	10	13.1	-530
50--99	24	76	51	6	48	17.2	-1,120
100 or more	25	172	51	6	49	18.3	-2,319
FARMS WITH A CROP INDEX OF 75 TO 149							
Less than 50 cuerdas	47	23	105	12	104	8.3	-450
50--99	21	67	109	9	93	12.3	-998
100 or more	30	201	105	9	95	15.5	-2,504
FARMS WITH A CROP INDEX OF 150 OR MORE							
Less than 50 cuerdas.	25	21	200	17	196	7.8	-233
50—99.	8	66	174	12	157	12.7	-333
100 or more	15	220	200	15	205	13.2	-1,666

EFFECT ON LABOR INCOME OF HAVING DIFFERENT FACTORS ABOVE THE AVERAGE

The effect on labor income of having different factors above the average is shown in table 29. It has already been demonstrated in preceding tables that during 1934 not all of the factors showed the same relation to labor income. Some were directly, while others indirectly related to labor income.

TABLE 29. EFECT ON LABOR INCOME OF HAVING DIFFERENT FACTORS ABOVE AVERAGE

224 COFFEE FARMS, PUERTO RICO, 1934

	Number of farms	Labor income
Average for all farms	224	$-1,120
AT LEAST ONE FACTOR ABOVE AVERAGE.		
Capital invested	72	-2,273
Total cuerdas in coffee	81	-2,128
Cuerdas in crops per man equivalent	104	-1,402
Labor costs per cuerda in crops	95	-1,312
Yield of coffee per cuerda	90	-857
Crop index	88	-791
Gross returns per cuerda	84	-691
AT LEAST TWO FACTORS ABOVE AVERAGE:		
Total cuerdas in coffee and capital invested	61	-2,470
Total cuerdas in coffee and gross returns per cuerda.	25	-1,587
Cuerdas in crops per man equivalent and yield of coffee per cuerda	27	-1,196
Labor costs per cuerda in crops and gross returns per cuerda	48	-992
Crop index and yield of coffee per cuerda	74	-717
Crop index and gross returns per cuerda.	54	-607
Total cuerdas in coffee and crop index.	12	-590
AT LEAST THREE FACTORS ABOVE AVERAGE:		
Capital invested; total cuerdas in coffee; and labor costs per cuerda in crops.	25	-2,882
Crop index; gross returns per cuerda; and yield of coffee per cuerda.	48	-529
Total cuerdas in coffee; crop index; and gross returns per cuerda	9	-487

The average labor income on those farms having at least one factor above average ranged from \$-2,273 to \$-691. On those farms with at least two factors above average it varied from \$-2,470 to \$-590. On the farms with at least three factors above average the labor income also showed considerable variation, ranging from \$-2,882 to \$-487. It is, therefore, apparent that a farmer in order to increase his profits or reduce his losses should have a suitable combination of factors above the average.

SUMMARY

This farm management study consisted of 224 coffee farms in Puerto Rico. The study was conducted by the Division of Agricultural Economics of the Puerto Rico Agricultural Experiment Station during 1935, and covered the calendar year 1934.

The average size of the farms was 186 *cuerdas,* with 88.5 *cuerdas* in coffee. Forty-two per cent of the coffee bushes were still under bearing age.

There was an average investment of $15,580 per farm. The value of land alone constituted 83.4 per cent of the investment.

All of the farms studied were still in a period of reconstruction, following the effects of the 1928 and 1932 hurricanes.

The average labor income on these farms was $–1,120 during 1934. Only 9 per cent of the farmers made positive labor incomes, averaging $414 per farm. Seven farmers made labor incomes of $500 or more.

Labor income showed an indirect relationship with all measures of size of business, and a direct relationship with the measures of efficiency of operation. In none of the tables included in this study was a positive labor income obtained for any of the groups of farms.

Farms operated by the owners themselves did not lose as much money as those operated either by the owner and a *mayordomo* or by salaried managers.

Farms located on dirt roads made better labor incomes than those located either on highways or off the roads.

Every coflee farmer in Puerto Rico should compare his farm with the averages given in table 13, and try to make his farm better than average in every point, particularly those in which it falls below the average.

THE MEXICAN COTTON BOLL WEEVIL, *ANTHONOMUS GRANDIS* BOHEMAN, IN HAITI

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The known distribution of the Mexican cotton boll weevil, *Anthonomus grandis* Boheman, until recently has been the southeastern United States and the cotton-growing regions of both the Pacific and Gulf coasts of Mexico, but not including the central plateau known as the Laguna district, nor the eastern and central part of Yucatan. Only a few authentic records are known of its presence in Central America. It has several times been recorded from the Island of Cuba in the West Indies, but its scarcity there is due to the fact that cotton is not a commercial crop, and even the wild cotton may at times be so completely destroyed temporarily by hurricanes that over large areas the insect may cease to exist for a series of years. In such areas, cotton is at times commercially grown without being attacked by the weevil, but, possibly due to the later appearance of this pest or more probably to economic factors and the inertia favoring other crops, has never succeeded in becoming permanently established. The presence of the boll weevil is indeed mainly of importance, not in Cuba itself, but in constituting a threat to the nearest large island to the east, Hispaniola, where cotton is extensively grown and has long been one of the major exports from the Republic of Haiti. At its narrowest point, between Punta Maisí of eastern Cuba and Cap du Mole of northwestern Haiti, the Windward Passage is only fifty miles wide, but, so far as known, the boll weevil has never by its own efforts bridged this gap in sufficient numbers to become established in Haiti.

It is supposed that *Anthonomus grandis* was introduced by accident into Haiti, probably in the personal effects of returned emigrants from Cuba, or in commerce by boat from Texas, about 1932. It is most curious that it was found at this time near two ports, Jacmel in the south of Haiti, and Gonaives in the west, neither of which is near Cuba. The first indication of its presence was the unusual number of fallen squares noted for the crop of 1932–33 by cotton growers close to Jacmel, but the loss was not sufficiently severe to cause alarm at that time. During the season 1933–34, the infesta-

tions had spread to the regions around Gosseline, Lafond, Meyer and Cayes–Jacmel itself, but the intensity of the infestation was so light as to attract little attention from the growers. By the end of January 1935, however, the crop was a complete loss in the Jacmel region. Typical was the loss of Monsieur Désenclos, from a normal yield of 50,000 lbs. of cotton, to a low of 300 lbs. in that year. MM. Barreau and Valvil, of Carrefour Fauché, lost their entire crop.

A general survey made at the beginning of the year 1935 showed that the weevil was close to Port-au-Prince, at Bolosse, Bourdon, etc. All the area between Port-au-Prince and Grand Goâve was infested, as well as the entire plain of Gonaives from Savanne Désolée to Ennery. Towards the end of the crop, in May and June, the dispersion had reached Petionville and the road from Frère, and in the Department of the South had reached Carrefour Desruisseaux near Miragoâne.

By June 1935, the boll weevil had become established to the north and east of Port-au-Prince, and before the end of the harvest it had reached the neighborhood of l'Arcahaie and the lower slopes of Morne á Cabrits. In the Département du Sud, the Plaine d'Aquin became so completely infested that, altho at that time the entire region around Cayes was still not infested, for quarantine purposes it was considered so, and the restrictions, which had greatly hampered commercial traffic in and out of this region, were removed.

Up to the present time, the regions of Saint-Marc and of the Plateau Central have remained free from the pest, under the protection of a very severe quarantine. It has been found also, that in the Plaine de Cul de Sac, the trade winds blowing from Petionville and Ganthier towards the west tend to carry out to sea any weevils in flight, thus protecting, to some extent, the region to the north. But while the Plateau Central is in addition protected by zones where cotton does not grow, the Savane Diane and the Morne á Cabrits being thus in little danger of infestation by natural spread of the weevil, there are many chances that the region of Saint-Marc will become infested in the near future because of the great amount of traffic between l'Arcahaie and Saint-Marc. Its natural spread would otherwise be hindered by the relatively arid zone of Magazins Carriès.

If the region of Saint-Marc, as is to be feared, becomes infested this year, a special watch should be kept to retard the entrance of

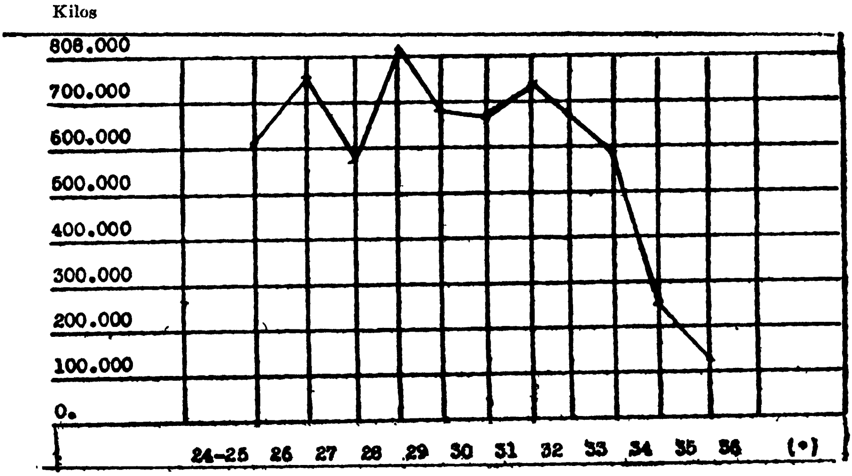
the weevil into the Plateau by the Vallee de l'Artibonite (Les Verrettes, la Chapelle and Mirebelais).

Extent of Losses

The records kept at the port of Jacmel facilitate a study of the losses suffered since the appearance of the boll weevil, as only the cotton grown in the immediate vicinity of Jacmel is exported from this port, and the region is entirely infested except at Cotes de Fer, of which the production is divided between Cayes, Petit Goâve and Jacmel.

Table No. 1

EXPORTATION OF COTTON FROM JACMEL, 1924 TO 1936



(*) From October to June 30, 1936.

Before the appearance of the boll weevil, the average exportation of cotton from Jacmel was 639,469 kgrs., the average of nine years. Because of the efforts of the Service Technique de l'Agriculture, and due to the encouragement of a good price, in 1931–32 the production increased to 740,890 kgrs., and in 1932–33 (the year in which the weevil is supposed to have been introduced, but before it had begun to attract attention or do much damage) the production was still above the average, or 670,013 kgrs. By 1933–34, this had decreased to 481,091 kgrs., in 1934–35 to 238,074 kgrs. In 1935–36, the production has again been halved, to 116,381 kgrs.

Considering 0.15 gourdes ($.03 in U. S. Currency) as the minimum price per pound of raw cotton, and taking the nine year aver-

age as the normal production from Jacmel (639,469 kgrs. = 4,000,000 pounds), the losses may be listed as follows:

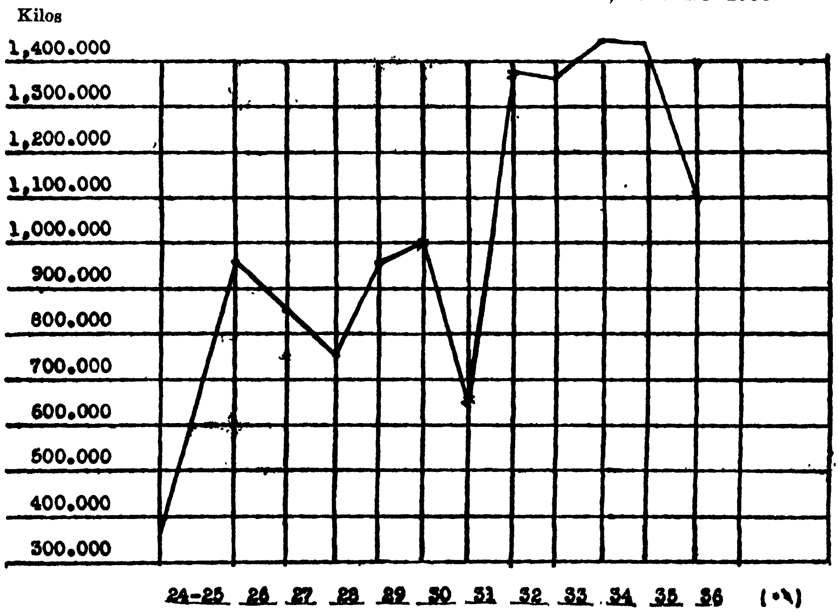
1933–34—1,100,000 lbs. of raw cotton, valued at	165,000 gdes.
1934–35—2,500,000 lbs. of raw cotton, valued at	375,000 gdes.
1935–36—3,200,000 lbs. of raw cotton, valued at	480,000 gdes.
	1,020,000 gdes.

This is an average of more than 300,000 gdes. ($60,000 in U. S. currency) a year lost by the cotton growers of the region of Jacmel, without taking into consideration the losses of the exporters and all others interested in the cotton trade at this port.

The records available for Gonaives do not show so clearly the extent of the damage caused by the boll weevil around this port because it also exports a large part of the cotton from the Plateau Central, where the area planted has greatly increased in recent years.

Table No. 2

EXPORTATION OF COTTON FROM GONAIVES, 1924 TO 1936



(*) From October to June 30, 1936.

Nevertheless, the above curve shows that, in spite of the great impulse recently given to the growing of cotton, production has remained stationary, even slightly decreasing in 1934–35. The de-

crease in production seems likely to become more significant this year, since from October to June, 1936, the exportation has been only 1,136,069 kgrs., while during the same period last year 1,392,810 kgrs. had been exported, a decrease of about 9 per cent.

This year, for the period October to June, Port-au-Prince and even Saint-Marc show similar decreases in production:

	Saint-Marc	Port-au-Prince
1934-35	2,370,778 kgrs	1,603,112 kgrs
1935-36	2,116,144 kgrs	1,487,255 kgrs.
	A decrease of 9%	A decrease of 9%

Such is the present situation, with little promise for the future. It is certain that as long as the entrance of the boll weevil into the region of l'Artibonite and the Plateau Central can be retarded, and especially if at the same time the area planted to cotton in that region is increased, the effect of the boll weevil on total production of Haiti will not at once be noticeable. But if Saint-Marc, which exports 40 per cent of the total production of the Republic, and the Plateau Central, whose production is 20 per cent of the total crop, become infested to the same extent as Jacmel the total production of the Republic will be sharply and permanently decreased. It is absolutely certain that the boll weevil is not a temporary pest, which we can hope to get rid of in the future. It will be impossible to eradicate the weevil now that it is so firmly established here. The problem is not how to get rid of the boll weevil, but how we can maintain cotton production despite its presence.

The question is at once raised whether it is possible to maintain cotton production at the present level with the native perennial type of cotton and present methods of growing the crop. Is it possible for the ordinary farmers (who produce more than three-fourths of the total crop) with their limited means, to increase the production of their farms to compensate for the destruction caused by the boll weevil? Or can the farmers be induced to increase the area devoted to the production of cotton so that from more plants they obtain the same total yield as before the appearance of the weevil? Judging by the attitude of the farmers who lost their crop last year from boll weevil, it seems most probable that very few ordinary farmers will either have the means to increase the yield or feel sufficient incentive to increase the area under cultivation.

Is cotton growing then to be abandoned in Haiti, and if so, what other crop can take its place? It is certain that if a crop could be found, capable of giving the same financial returns as cotton in less

than five years, in the semi-arid soils known as "cotton soils", it would be wise to make the change. That being uncertain however, and considering the general dislike of farmers for new crops, the desirability of substituting an annual, short-season type of cotton for the perennial type now grown has been suggested.

In its relations to the boll weevil, the Haitian type of perennial cotton has a number of disadvantages. Being a perennial type of cotton, it furnishes fresh green leaves for the nourishment of adult weevils during almost the entire year. Furthermore, its large size and abundant foliage so completely shades the ground that the immature stages of the weevil in fallen squares and bolls are not killed by the heat of the sun on the bare ground between the rows as in the case of other kinds of cotton. Altho the production of squares is largely confined to two months, yet a sufficient number of squares are produced before and after this period to furnish a much longer possible period of reproduction for the weevil than in the case of the strains of American upland cotton especially selected for short season. An additional disadvantage, having nothing to do with the boll weevil, is its low yield, only a "millier" (one thousand pounds) of raw cotton per hectare under very good conditions.

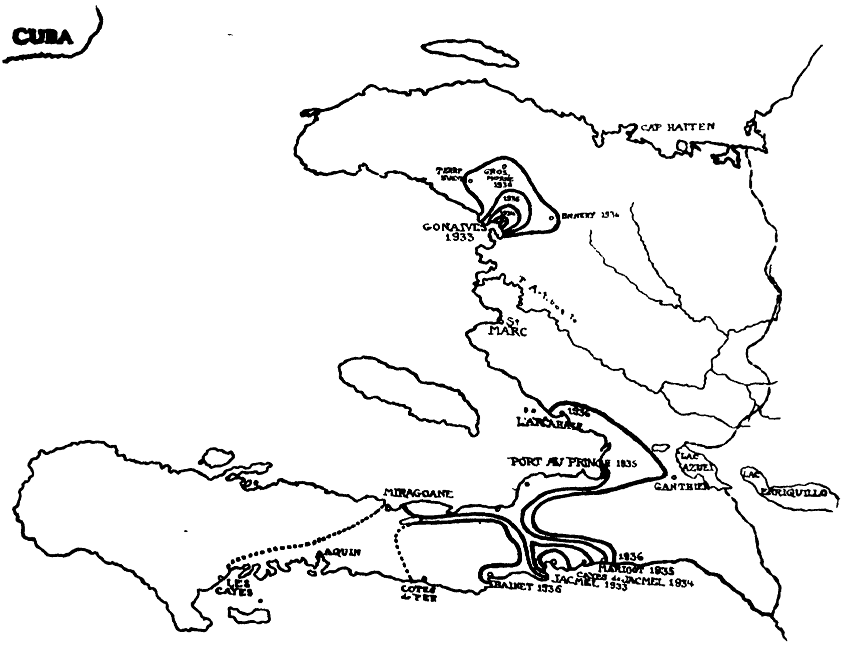
On the other hand, the native Haitian type of perennial cotton has certain unique advantages making it peculiarly suitable to Haitian conditions, at least up to the present. Foremost among its advantages is a resistance to the attack of the pink bollworm so marked that the commercial damage caused by this pest since its appearance in 1925 is negligible. When grown in experimental plots beside many other kinds of cotton, this resistance to pink bollworm attack is very marked, but when grown commercially in the absence of other varieties, the pink bollworm practically ceases to exist. During the beginning of the crop, rarely can more than one or two infested bolls be found in several hour's search, and even at the very end of the picking season, infestation is normally not more than 1 or 2 per cent, too little to be noted by either grower or exporter.

The Haitian farmer is used to the perennial type of cotton. It is not necessary to plant every year, and the same plants yield for several years, even if not cut back to the ground at the end of the picking season. Practically the only expense of growing cotton in Haiti is harvesting the crop and transporting to market, making the expense of production so low that even the small return on account of inferior quality and low yield nets the farmer an excellent profit. At present, that profit seems about to be eliminated by the boll weevil, but if the parallel of the pink bollworm is any criterium, the

appearance of this new pest may merely serve to eliminate the strains of native cotton most susceptible to its attack, just as the advent of the pink bollworm eliminated the foreign strains of Brazilian Kidney, Meade and other imported varieties mingled at that time with the Haitian perennial cotton.

Explanation of Map

The outline map of the Republic of Haiti is taken from the "Carte publiée par les Fréres de l'Instruction Chrétienne avec approbation du Département de l'Instruction Publique par sa letter en date du 9 Octobre 1931".



Haïti is the western part of the Island of Hispaniola, in the West Indies; the eastern part being the Republic of Santo Domingo. To the northwest is the Island of Cuba, fifty miles away; to the southwest is the Island of Jamaica, too far away to be shown.

The lines marking the dispersion of the boll weevil in Haiti were determined by the authors for the years as noted on the map itself.

The high mountain range which forms the southern peninsula of Haiti, locally "Presque Isle", is connected with the remainder of the island by the Plaine de Cul-de-Sac, only a few feet above sea leavel north of Port-au-Prince, and considerably below sea level at

the lagoons of Lac Abuei and Lac Enriquillo. This mountain range is sufficiently broken north of Jacmel to permit passage of a road, and it is along this road that the boll weevil gained access to the northern plain of Presque Isle. After becoming established north of the mountain range, it spread east to Port-au-Prince (1935) and l'Arcahaie (1936), and to the west to Miragoane (1935) and south across the mountains along the road to Aquin and Les Cayes.

The spread of the boll weevil from Gonaives (1933) is presumably determined by the prevailing winds from the southeast, keeping it out of the Plaine de l'Artibonite, and carrying it northwest to Terre Nueve (1936), while commerce is largely responsible for its spread along the road east to Ennery (1936) and north to Gros-Morne (1936).

THE DEVELOPMENT OF THE GIANT SURINAM TOAD, *BUFO MARINUS* L.

By FRANCISCO SEÍN, JR., *Assistant Entomologist,* Agricultural Experiment Station, Río Piedras, P. R.

On April 20, 1934, a strand of the eggs of the giant Surinam toad, *Bufo marinus* L., was collected in a brook at Monacillos, Río Piedras, Puerto Rico. The strand was found dangling from grass stems in swiftly running water, where it presumably had been carried by the current before becoming entangled in the grass. It was carried to the laboratory and placed in a large receptacle of water. where all changes could be readily observed. (Fig. 1.) The strand was transparent, with segmentation visible at the tips. The black, rounded eggs were embedded in the center of this strand.

On April 21, 1934, the eggs hatched, each tadpole pushing its way out of the main strand into branches or short lateral tubes. (Fig. 2, A and B.) The tadpoles later in the day left the branch tubes but remained attached to them externally. (Fig. 2, C.)

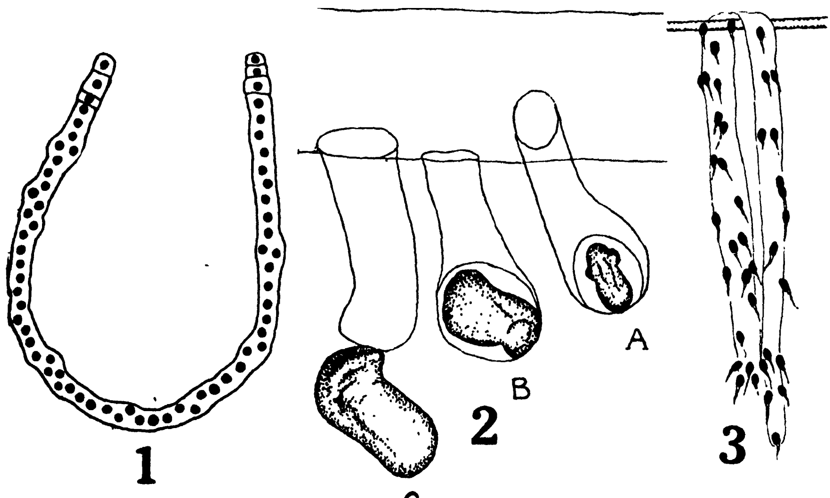


FIG. 1. Strand of eggs of the giant Surinam toad, *Bufo marinus* L.

FIG. 2. A section of the egg strand showing branches or lateral tubes. (A) and (B), the tadpoles still inside the tubes; (C), the tadpole outside the tube.

FIG. 3. The tadpoles with well developed tails clinging to the outside of the egg strand.

By April 23d, practically all of the tadpoles had become rounded and had developed tails, but they still remained attached to the egg-strand. (Fig. 3.) Shortly afterwards they abandoned it, dropping to the bottom and sides of the glass receptacle. They were fed lettuce, bread crumbs and occasional insects or earthworms, which were killed and cut up in small pieces for them. They were extremely fond of the earthworms and the bread. Large numbers of them feeding on a floating piece of bread would often cause it to slowly revolve, as it was pushed around by eager wagging of their tails.

By June 11th several tadpoles had developed hind legs, and by the 20th, two individuals had developed fore legs. One of these still had a complete tail, but the tail of the other had already begun to shrink and curve downwards between its hind legs. By the next day, the tail had become a stump and the toad left the water, being at that time only one-quarter of an inch long. From time to time during the summer, others became adult, but no record was kept, and food was supplied more sparingly.

On October 3d, 1934, the last tadpole had transformed to adult, nearly six months after the eggs were collected.

WHAT THE GIANT SURINAM TOAD, *BUFO MARINUS* L., IS EATING NOW IN PUERTO RICO

By George N. Wolcott, *Entomologist*, Agricultural Experiment Station, Río Piedras, P. R.

In the history of man's attempts to control pests by the introduction of some other animal to attack and destroy them are numerous instances of the later development of less desirable or injurious habits by the introduced animal after the numbers of the pest on which it is normally supposed to feed have been greatly reduced, and its shrinking supply of food must be augmented by the substitution of other items, neutral or even beneficial to man, if it is to continue to exist in large numbers. Such an eventual result has been predicted in the case of the giant Surinam toad, *Bufo marinus* L., in Puerto Rico.

Originally introduced in 1920 and 1924 to control white grubs in cane fields, it proved so extraordinarily successful within the next ten years, because of its decided preference for the adults (May beetles, or "caculos") of the white grubs, that they have now ceased to be of appreciable economic importance in all the more level coastal regions where cane is most extensively grown (3). It might possibly be expected that the toads, deprived of their main source of food and forced to find new sources or perish, would have already begun to be a much less desirable permanent addition to the fauna of the Island than when engaged in the elimination of the white grub pest. Their present status indicates, however, that such fears were quite unfounded. Altho not susceptible to statistical proof, it is a matter of common observation that toads are much less abundant now than a few years ago.

One possible contributing cause to their present comparative scarcity is that some insects or other animals already present in Puerto Rico before the importation of the toad, and of course quite unaccustomed to feed upon it or affect it in any way, have gradually learned to attack it. One such striking instance is the large number of predaceous diving beetle larvae (Dytiscidae), *Megadytes giganteus* Castelnau, as determined by Dr. S. E. Danforth, which have been noted developing recently in a pool only a few weeks previously well stocked with tadpoles of *Bufo marinus*. Presumably the fundamental cause of the scarcity of the toads, however, is lack of food, which may either prevent normal reproduction, or cause actual star-

vation of toads unable to change their habits and develop a broader basis of nourishment.

For determining whether the Surinam toad has changed its food habits in the last few years, the investigations conducted by Mrs. Raquel R. Dexter (1) in 1931, when the toad had presumably attained its maximum abundance in Puerto Rico, are most useful. She collected three hundred toads from eighteen localities, all of them in the lowlands or cane-producing sections of the Island, where the toads were very abundant at that time. The data given by her are based on stomach contents examinations, and are expressed in percentage of the total bulk of the food there found. Scarabaeid beetles, the adults of white grubs (neutral and non-injurious species, as well as the economic pests) she found to constitute 43.3 per cent of the total food of the toad at that time; millipeds one-fourth of the total, Curculionid weevils one-sixth and mole-crickets or "changas" only one-fortieth. The Scoliid wasp, *Campsomeris dorsata* F., a parasite on the larvae of the rough black Scarabaeid beetle, *Ligyrus tumulosus* Burmeister, was found to constitute 5.1 per cent of the food of the toad, while the host beetle adult was 12.0 per cent of the toad's food. Such intensive consumption of these two insects, host and parasite, could not fail to produce decisive results in lessening their numbers, an eventuality which was reported by the present writer (2) in 1934. The *Ligyrus* grubs are strictly saprophytic, and neutral in their relations to the interests of man, but those of the yellow-brown May beetles are the white grubs which were such serious pests of sugar-cane and other crops. Their adults formed over one-quarter of the food of the toad, and the result soon became obvious to every cane-grower on the Island. Millipeds are most common in well-rotted manure or compost heaps, or in old malojillo grass, and are of so little direct importance to man that not even estimates of their abundance are available. One of their most annoying habits was to crawl over the concrete porch of a house at the Experiment Station in such numbers during wet weather that no sooner were they swept away at one end than an equal number had already appeared at the other. This no longer occurs, and while millipeds can still be found in abundance in suitable locations, they seem much less numerous generally. Of all the important items in the food of the toad as noted by Mrs. Dexter in 1931, only the common Otiorhynchid weevils or "vaquitas", seem to have decreased slightly, if at all, since that time.

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The toads themselves are so much less numerous than formerly that considerably numbers can be observed only in the most favorable locations. A small, sluggish brook runs thru the grounds of the Agricultural Experiment Station at Rio Piedras, and on one side a considerable expanse of well-kept lawn rises in gentle slope. Even one casually crossing the lawn in the daytime will often note pellets of toad excrement on it, especially after two or three rainy nights when the toads have been active. An examination of these pellets gives by no means as exact a record of the food habits of the toad as would stomach examinations, for some items may be so lightly chitinized as to be completely digested. But so many of the normal items of the toad's food are heavily chitinized that their undigested remains in the excrement pellets may be taken as a reasonably accurate indication of the bulk of the food. The results of the examinations can not be expressed as bulk percentages, but only as numbers of the insects found. The first collections, made over a year ago at Rio Piedras, were few in number, and at the time little regarded, but when compared with the much more numerous collections of this spring are seen to be surprisingly similar. It should be noted, however, that these observations were confined to a single restricted locality, and that a somewhat wider range of food might be expected if examinations were made from more localities, and at other times of year.

Table No. 1.

The Contents of the Pellets of Excrement of the Giant Surinam Toad, *Bufo marinus* L., at Rio Piedras, Puerto Rico, 1935–36.

14 pellets, May 9, 1935, contained:

36 black Scarabeid beetles, *Parachalepus (Dyscinetus) barbatus* F.
3 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
2 cucubanos, *Pyrophorus luminosus* Illiger
1 cockroach, *Periplaneta americana* L.
1 stone

5 pellets, Sept.–Oct., 1935, contained:

21 black Scarabeid beetles, *Parachalepsus (Dyscinetus) barbatus* F.
4 common Otiorhynchid weevils, or "vaquitas", *Diapreps abbreviatus* L.
1 large brown May beetle, *Phyllophaga (Lachnosterna) portoricensis* Smyth
1 blade of grass

58 pelelts, April 23–28, 1936, contained:

118 black Scarabaeid beetles, *Parachalepsus (Dyscinetus) barbatus* F.
195 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
6 small brown May beetles, *Phyllophaga (Lachnosterna) citri* Smyth
1 rough black Scarabaeid beetle, *Ligyrus tumulosus* Burmeister
1 common Otiorynchid weevil, or "vaquita", *Diaprepes abbreviatus* L.
4 leaves
2 stones
1 seed

12 pellets, collected September 14, 1936, contained:

54 black Scarabaeid beetles, *Parachalepus (Dyscinetus) barbatus* F.
2 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
3 common large Otiorhynchid weevils, *Diapreps abbreviatus* L.
1 large bee ??
1 cockroach, near *Pycnoscelus*
1 large Pentatomid bug, *Nezara viridula* L.
1 large scorpion
1 milliped
grass
vegetable fiber
mud

1 pellet, collected September 20, 1936, at Loíza Aldea, in field of young plant cane where changa tunnels were abundant, contained:

2 large brown May beetles, *Phyllophaga (Lachnosterna) portoricensis* Smyth
4 common large Otiorhynchid beetles, *Diaprepes abbreviatus* L.

1 pellet, collected October 20, 1936, at Central San Vicente, Vega Baja, in field of young ratoon cane, "poyal" land, contained:

5 rotten cane stalk weevils, *Metamasius hemipterus* L.
2 common large Otiorhynchid beetles, *Diaprepes abbreviatus* L.
1 large dark green Cicindelid beetle, *Tetracha sobrina infuscata* Mann.
2 millipeds

For instance, the rough black Scarabaeid, *Ligyrus tumulosus* Burmeister, occurs normally in sandy land, and in sandy localities doubtless still forms an important item in the food of the toad, together with its wasp parasite, *Campsomeris dorsata* F. On the other

hand, it is quite inexplicable that of the two common small black Scarabaeid beetles; *Parachalepus* (*Dyscinetus*) *barbatus* F. and *Dyscinetus picipes* Burmeister (= *D. trachypygus* Burmeister), only one of the latter should be found eaten by the toads in Río Piedras in 1935–36, for in past years collections (by entomologists) of both species in abundance have been made there as well as in other parts of the Island.

The inclusion of stones and vegetable matter in the excrement of the toads was probably accidental, and incidental in obtaining the living items in their food. The absence of millipeds is possibly due to local scarcity on the lawn, for a single pellet examined in August 1936, picked up from beside a compost heap containing millipeds, was found to contain nothing else but their remains and earth. Of the insects other than the Scarabaeid beetles, it is a matter of common observation, and great regret, that the cucubano, *Pyrophorus luminosus* Illiger, is so much less common now at Río Piedras than it was before the introduction of the toad. In the mountains of Puerto Rico, where toads are noticeably scarce, the cucubano seems to be quite as abundant as it ever was. Thus it would appear that the cucubano continues to occur in normal abundance in the mountains because of the permanent scarcity of the toad there, while in the moist lowlands it barely manages to survive. The scarcity of the common Otiorhyncid weevil, or "vaquita", *Diaprepes abbreviatus* L., in the pellets of toad excrement examined is accidental, and possibly due to a temporary scarcity of the adults at the time the pellets were collected, for the insect still seems very abundant, and despite its normally aerial and diurnal habits, in previous years was an important item in the food of the toad.

It would thus appear that, while no decided change in the food habits of the toad has occurred in recent years due to the increasing scarcity of May beetles, the even greater scarcity of some of the other insects and other animals previously eaten makes the trend towards an even more exclusive selection of the adults of white grubs for its food. Such a statement seems hardly logical, yet the data point to no other conclusion. It indicates that the introduction of *Bufo marinus* into Puerto Rico for the control of white grubs was not only an immediate and temporary success, but tends, at least so far as the food habits of the toad determine its trend, continually to become more effective and more permanent.

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THE ORGANISM CAUSING THE DRY TOP ROT OF SUGAR CANE

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This organism and the disease caused by it are very interesting because they were not known outside of Puerto Rico * for several years following their discovery and because of the problem involved in the taxonomy of the organism.

Matz (**10**) published the first description of the organism in 1920 under the name of *Plasmodiophora vascularum.* Two years later he published a second paper (**11**) in which he gave additional data.

Some doubt was expressed as to the taxonomic position of the organism which led the writer to make a study (**1**) which resulted in the transfer of the organism to the genus *Ligniera.* This was questioned by several workers and especially by Dr. W. R. Ivimey Cook of the University of Bristol, England, who started a correspondence with the author. Finally the author sent a collection of material to Dr. Cook of Bristol for study. As a result of these studies Dr. Cook decided that the disease was due to Rhizopods and prepared a paper (**6**) in which he described a new genus and two species, *Amoebosperus vascularum* and *A. saccharinum.* The writer disagreed with Dr. W. R. Ivimey Cook and immediately started a series of studies which have been continued to the present time. The results of these studies are recorded in this paper. In these studies the writer has examined a very large amount of material, fresh and in micro-preparations. All stages in the development of the organism are found without difficulty except the germination of the spores and the zoospore stages. However, sufficient material showing these stages was found to satisfy the writer that there is but one organism and that it does not belong to *Plasmodiophora* or to the *Protozoa.*

The organism passes into the new shoots of the cane as a plasmodium. This was demonstrated in fresh material from the field and in plants grown in pots in the green house and in water in glass cylinders in the laboratory. No stage other than the plasmodium

* It was found in Venezuela a few years ago. Probably introduced from Puerto Rico.

was found in these young shoots and this plasmodium was always in the tracheary tubes. In the older canes it could be found in the other cells. The writer failed to find any nuclei in this plasmodium until the formation of the spores as described in the first paper (1). The nuclei appear with the formation of the spores (Figs. 1, 2 and 3) and have very much the same appearance as that stage of *Woronina polycystis* as figured by Cook and Nicholson in 1933 (8). These plasmodia in the older canes very frequently contain large bodies which the writer believes to be resting spores that have not germinated (Fig. 2). Dr. W. R. Ivimey Cook calls them empty cysts from which the spores have emerged. These resting spores or cysts can be found in great numbers and completely filling sections of the tracheary tubes. These large spores with very thick walls are to be found in the tracheary tubes (Figs. 8 x) and sometimes in the other cells (Figs. 8 *y* and 16). The writer has observed large zoospores in those resting spores (Fig. 6, *a*, *b*, *c*) but has never observed the formation of a large number of spores in them as described by Dr. W. R. Ivimey Cook.

The writer has observed many spores which were variable in size and to some extent in form in both tracheary tubes and in the surrounding cells (Figs. 8–20). Spores that are fairly uniform in size and shape may occupy certain cells while in other cases the spores in a cell or tracheary tube may be variable in size.

The cells, other than these in the tracheary tubes that contain either plasmodia or spores develop very thick walls (Figs. 8, 10, 13, 15 and 16). These spores appear to be the same as those which W. R. Ivimey Cook designated as cysts.

A careful study of the work of Matz, W. R. Ivimey Cook and the writer shows a very general agreement of some points but different interpretations. A comparison of all the studies by these three workers, including the data in this paper is as follows:

All have aged that the organism lives in the fibro-vascular bundles. Matz states that it lives in the annular and spiral trachiedes and pitted vessels. The writer found the organism in the tracheary tubes, in the surrounding cells of the fibro-vascular bundle and sometimes in the parenchyma cells, especially in the older canes. In the very young canes it was confined to the tracheary tubes. W. R. Ivimey Cook reports *A. vascularum* in the spiral and annular tracheids and in the pitted vessels of the vascular bundles, and *A. saccharinum* in some of the cortical cells as well as in the phloem and xylem parenchyma but never in the xylem vessels.

Both Matz and the writer describe a plasmodium, while W. R. Ivimey Cook used the terms amoebae and amoeboid. Matz makes no mention of nuclei in the spores but his drawings show them. Both the Cooks state definitely that they failed to find nuclei in the spores. The writer has examined a large number of plasmodia (W. R. Ivimey Cook's amoeba) and failed to find any evidence of nuclei. However, as soon as the plasmodium begins to form spores the nuclei appear (Figs. 1 and 2).

Matz did not succeed in germinating the spores in sugar water, cane juice, in fermented cane juice or in several agars. The writer germinated many of the large spores, which W. R. Ivimey Cook called cysts in sterilized, distilled water.

The writer reported the formation of germ tubes in these old spores in his first paper but no evidence of swarm spores. In his later studies he found these resting spores or cysts could be germinated in sterilized distilled water. They were mounted in sterilized distilled water on slides and kept in moist chambers for one or more days. A few resting spores which had been kept in this manner showed a very slow internal movement as one large zoospore (Fig. 6 *a* and 6 *b*) sometimes moving in one direction and sometimes in the other. In one case a cell wall had been formed and two moving bodies were observed (fig. 6 *c*), one in each cell. In another case three walls were formed indicating a quadrant (Fig. 6 *d*) but there was no internal movement. These resting spores developed short germ tubes (Figs. 6 *e* and 7 *a*) by which the zoospores emerged but the writer did not observe the emergence of them. However, many empty spores with open germ tubes and a few free swimming zoospores were observed. The zoospores rotated very slowly and in the same manner as those that were confined to the resting spores (Fig. 7 *b*). No cilia could be seen with a high power, oil immersion lens. Several of these zoospores were studied and found to develop a very slowly moving amoeboid form (Fig 7 *c*). It is very evident to the writer that they represent this stage in the life history of the organism in the tracheary tubes of the host plant and that they unite to form the plasmodium. It is possible that zoospores in wet soil undergo the same transition. No nuclei were visible in this stage but the writer did not stain any of them.

A single flagellate spore was reported in the writer's first paper. It was in the tracheary tube in a prepared micro-section. No others have been observed by the writer. Dr. W. R. Ivimey Cook reported both amoeboid and flagellate stages. The writer did not

observe the formation of a large number of spores such as were described by Dr. W. R. Ivimey Cook but the studies of the latter were necessarily confined to dead material. Therefore, it was impossible for him to make any studies on germination.

Very large resting spores (W. R. Ivimey Cook's cysts) with thick walls are to be found in the tracheary tubes, sometimes filling them for a considerable distance (Fig. 8 *x*). They are sometimes found in other cells (Figs. 8 *y* and 16).

Matz reports that "sometimes these vessels were filled with a mass of granular protoplasm containing all stages between numerous, small, immature, ovate bodies of various sizes and the mature, spherical, larger spores". The writer found a variation in size and character of spores (Figs. 11 and 12) but believed them to be stages in the life history of a single organism. The results of the studies recorded in this paper support this opinion. Dr. W. R. Ivimey Cook believes them to be stages in the life history of the two different organism which he described. Matz does not mentioned nuclei in the spores but his drawings show them. Both Dr. W. R. Ivimey Cook and the writer found very definite nuclei.

The writer has observed many spores which were variable in size and to some extent in form in both tracheary tubes and in the surrounding cells (Figs. 8–20). Spores that are fairly uniform in size and shape may occupy certain cells while in other cases the spores in a cell or tracheary tube may be variable in size.

The spores, other than those in the tracheary tubes that contain either plasmodia or spores, develop very thick walls (Figs. 8, 10, 13, 15 and 16).

The plasmodia in the tracheary tubes and cells of other tissues had the same general appearance (Figs. 2 and 15). The large resting spores in the tracheary tubes and in other cells (Fig. 8) had the same general appearance and the writer does not believe that they were due to different organisms. Large and small spores were to be seen in the tracheary tubes (Figs. 10, 11, 12, 14 and 17) and in various other tissues (Figs. 10 and 13). The relationship of these large and small spores has not been established and the writer believes them to be stages of the one organism. If not, it is very evident that two parasites generally occupy the same cells at the same time.

W. R. Ivimey Cook writing of *A. vascularum* says:

"Germination of the spores is difficult to observe, and the author is not certain that the following stages form part of the same life-cycle. As far

as he can see the spores germinate to produce a small spherical body containing a clearly marked nucleus in which there is a vacuole associated with the nucleus. The protoplasm late becomes more vacuolated as the amoeba grows."

In writing of *A. saccharinum* he says:

"The amoeba finally became surrounded with a cyst wall and the contents divided up into a number of small spherical cells each of which contained a single nucleus. . . . Fixation must have occurred during the process, since, while some of the spores, remain within the cyst, others have left it. As far as could be made out these bodies are provided with an apical flagellum, and at this early stage are pyriform in shape, though later they became rounded."

Matz in his second paper discribed a division of spores into two, four and sometimes six parts. Dr. W. R. Ivimey Cook described a division in both his *Amoebosporium saccharinum* and his *A. vascularum*. The writer found a stage that appeared to be a division of the nuclei (Figs. 3 and 4) but failed to follow a life history such as that described by Dr. W. R. Ivimey Cook. Dr. W. R. Ivimey Cook also speaks of the protoplasm surrounding the empty cysts which is apparently the same as shown in figure 2. In my first paper on this subject I described this as a spore which had failed to germinate. Since that time I have examined a large number and am inclined to adher to that view. I have never found any of these spores with an opening in the wall, unless a germ tube had been formed.

Dr. W. R. Ivimey Cook speaks of the division of the nucleus in these large spores and the formation of a number of small spores. I have not been able to confirm his views in either case. The nuclei stain readily until the spores are almost mature (Fig. 5) but it is practically impossible to stain them in old resting spores (Figs. 2 and 8).

Dr. W. R. Ivimey Cook states that his *Amoebosporum vascularum* is found in the spiral, annular and pitted vessels of the vascular bundles and that his *A. saccharinum* is found in some of the cortical cells as well as in the phloem and xylem parenchyma, but never in the xylem vessels.

I have found what I believe to be one species in both tracheary tubes and in the fibrous cells (Figs. 14, 15, 16) and sometimes in the parenchyma. Also, I have found small spores in both tracheary tubes and in the fibrous cells (Figs. 9, 20). Sometimes I find both the large and small spores in the same tracheary tubes (Figs. 10–12) and the same in the fibrous cells (Figs. 18–20). I believe them to be stages in the life history of a single organism. I cannot harmonize Dr. W. R. Ivimey Cook's results with my studies on the germination of the large spores. However, it should be remembered that Dr. W.

R. Ivimey Cook's studies have been restricted to the material which I sent to him while I had the advantage in that I studied fresh material throughout the year for several years.

One point which has not been mentioned in any of the previous papers is that when fibrous cells are inhabitated they always develop very thick walls, apparently the result of stimulation (Figs. 8–16).

Let us now turn our attention to the presence of this organism or organisms in the roots. Thus far my studies on this phase of the subject have been very limited but it is reasonable to suppose that the penetration is through the roots. This has not been observed but I have found the plasmodium in the roots, and Matz and the writer have found the spore stage.

Method of Infection

The method by which healthy plants become infected with this organism has not been definitely determined. Judging from the environmental conditions under which infections take place, the life history of the organism as traced in this paper and the life history of other organisms belonging to the Plasmodiophoraceae we are justified in believing that zoospores are formed and that they penetrate the roots of healthy canes. This has not been observed but Matz reported the finding of the organism in the roots of growing cane and the writer has found both the plasmodium and spores in the tracheary tubes of the roots.

The Taxonomic Position of the Fungus

The taxonomic relationship of this organism presents some rather interesting questions. My recent studies convince me that it does not belong to the Plasmodiophora or the Protozoa. It does not show nuclei in the plasmodium by any of the methods used. It is found mostly in the tracheary tubes and it does not cause hypertrophies.

It differs from the genus Sorosporaera in that it is not restricted to the roots but is most prominent in the stems and the spores are not collected into hollow masses.

It differs from the original description of the genus *Ligniera* in that it is not restricted to the roots but is most prominent in the stems but it resembles this genus in that it does not produce hypertrophies and in having the spores collected in masses.

The writer has made a careful study of the literature beginning with 1911 when Maire and Tison (**12**) erected the genus *Ligniera*. **They said:**

"The difference between the swellings produced by *Plasmodiophora Brassicae* and those produced by *Sorosphaera Veronicae* is that the cells of *Veronica* show towards the end some mitosis that are not accompanied with cell wall formation, while in the case of cabbage the formation of cell walls follows the mitosis to the end.

"The study of *Ligniera* throws a new light on the affinities of the *Plasmodiophoraceae*. The *Ligniera* are very similar to the *Rhizomyxa hypogae Borzi*, also a non hypertrophiating parasite of the roots of various plants. That Rhizomyxa, according to Borzi, (1884) is a complex of various organisms and certainly the Ligniera were included in the complex. One of the drawings of Borzi represents *L. verrucosa* (that apparently grows on *Trifolium resupinatum*); other drawings suggest *L. radicalis* and *L. junci*. However, the real *Rhizomyxa hypogae* within the narrow limits given by A. Fischer (1892), characterized by the presence of zoospores within the thin walls containing several zoospores, such zoospores are not present in the *Ligniera*. The *Ligniera* are similar to the *Voronina polycytis* Cornu, whose balls of kystes remind one of the balls of spores of the *L. verrucosa*. It is quite possible that the *Ligniera* are derived from organisms similar to the Woronina through the disappearance of the zoosporocytes. The original of the Plasmodiophoraceae might be looked for in the studies of the Chytridiales.

"Nemec (1911) just described a Chytridiales of the Woroniaceae group, the *Sorolpidium Beta*, (**13**), parasites on the roots of Beta. That Chytridiales show plasmodia similar to those of the Ligniera, real zoosporocytes very similar to those of the Rhizomyxa. One can observe mitoses of a type similar to those of Plasmodiophoraceae. The author confirms our opinion as to the origin of the Plasmodiopraceae. They seem to be different from the Woroniaceae through the disappearance of the zoosporocytes."

Maire and Tison included in this genus two species which they had described, *L. verrucosa* living in the roots of *Voronica arvensis* and *L. radicolis* living in the roots of *Callitriche stagnalis*. They also transferred *Sporosphora junci* to this genus because it caused little or no hypertrophy of the roots and because the spores were not arranged in any definite system. In the following year Winge (1912) transferred *Sorosphaera graminis* to this genus.

Schwartz (1914) published a paper (**16**) on the *Plasmodiophoraceae* and their relationship to Mycetozoa and Chytriadiae in which he recognized seven genera as follows; 1. *Plasmodiophora*, 2. *Sorosphaera*, 3. *Tetramyxa*, 4. *Sorodiscus*, 5. *Molliardia*, 6. *Spongospora* and 7. *Ligniera*. The first five cause hypertrophies; the last two do not. In plasmodiophora the spores are free: in *Sorosphaera* they are collected into hollow spheres; in Ligniera they are collected into masses of varying shapes (e. g. spheres and ellipsoides).

In his discussion of the genus *Ligniera* he says,—

"The genus which is closely allied to *Sorosphaera*, was formed by Maire and Tison to include these members of the Plasmodiophoraceae in which the spore

clusters are most usually ellipsoidal and irregular shaped and rarely spherical. A common characteristic of the members of this genus is that they do not give rise either to hypertrophy of tissue or to nuclear degeneration in the host plant.''

He also says that all the species of this genus are root parasites living in the outer cortex and that the infection is through the root hairs.

W. R. Ivimey Cook (1926) published a paper on the genus Ligniera (2) in which he repeated the description of the genus as given by Maire and Tison which is as follows:

''In cellulis hospitis immutatis parasitans: nec tumores gignons; schizogina reducta; sporae in acervales variforme conjunctae.''

He says,—

''The full grown amoeba may be compared with the plasmodium of the Mycetozoa, which it resembles very closely. The size of the full-grown amoeba is usually limited by the size of the host cell, though if this cell is very large the contents may become exhausted before the amoeba has completely filled it.''

In the summary of this paper he says,—

''The genus *Ligniera* is a member of the plasmodiophoraceae, and has many points of relationship with the Mycetozoa. It differs from any other member of the group in not causing any hypertrophy of the host tissue.''

In 1928 Dr. W. R. Ivimey Cook (3) published a paper on the Methods of Nuclear Division in the Plasmodiophorales in which he said,—

''The Plasmodiophorales show a great similarity to the Amoeba in their methods of nuclear division. They show some similarity to the Mycetozoa in their life-history. It is considered probable that the two groups have originated from a common ancestor in the evolutionary series from Protomyxa to the Lobosa. Owing the presence of Protomitosis it is considered that the Plasmodiophorales have become separated before the Mycetozoa were. There is no common grounds for considering that the Plasmodiophorales and Chytridiales are closely related; the position of the *Soroledipium betae* does not support such an assumption.''

Cook and Schewartz (1929) in their paper (4) on *Sorosphaera radicale* said,—

''These zoospores however, bear a close resemblance to those previously observed in *Ligniera junci* and those described by other workers in the genera *Spongospora* and *Plasmodiophora.*

''It is the structure of the spore mass which renders this species easily distinguished from any previously described. In *L. junci* and *L. verrucosa* which have been known to attack grass roots the spores are not arranged in

any definite system, though at times they appear to be grouped in a more or less spherical mass. In the genus Sorosphaera, of which only *S. verronicae* has been described, the spores are arranged in a hollow sphere.''

W. R. Ivimey Cook (1930) in a paper (**5**) on *Plasmodiophora brassicae* referred to the transfer of this species from *Plasmodiophora* to *Ligniera* by the writer of this paper and said,—

> ''Cook prefers to place the organism in the genus *Ligniera,* because it does not cause hypertrophy of the host tissues, but in our opinion (based on the two accounts which we have read) there is very little ground on which to refer it to either genus.''

W. R. Ivimey Cook (1933) published ''A monograph of the Plasmodiophorales'' (**7**) in which he recognizes six genera: (1) *Plasmodiophora,* (2) *Sorosphaera,* (3) *Sorodiscus,* (4) *Spongospora,* (5) *Tetramyxa* and (6) *Ligniera.* In his key the first five form a group and *Ligniera* is separated but in his diagram showing the phylogeny it is placed as an offshoot or branch of Plasmodiophora. In his discussion of this genus he says that Fitzpatrick ''fails to recognize the difference between the genera *Ligniera* and *Sorosphaera.*''

W. R. Ivimey Cook and E. J. Schwarts (1929) published a paper (**4**) on a new species, *Sorosphaera radicale* in which they said,—

> ''This new species seems to indicate that there is a definite relationship between the genus *Sorosphaera* and the genus *Ligniera,* and that hypertrophy is not a feature upon which too much importance must be based. Despite the comparatively close affinity between the two genera, it is a matter of very great difficulty to determine which of the two should be considered the more primitive. If, as has been pointed out before, spore systems are considered more advanced than scattered spores then *Sorosphaera* has been evolved from *Ligniera.*''

Fitzpatrick (1930) (**9**) recognized but five genera: (1) Plasmodiophora, (2) Tetramyxa, (3) Sorosphaera, (4) Sorodiscus and (5) Spongospora. In Plasmodiophora the spores at maturity are not united and are free in the host cells. In Sorosphaera the spores are united into more or less definite spore balls which are spherical to ellipsoidal, hollow and consisting of a peripheral layer of spores enclosing a central cavity. He refused to recognize the genus Ligniera with the following statement,—

> ''As the genus *Ligniera* Maire & Tison was based merely on a host reaction the writer is wholly disinclined to accept it as valid. It is clear that two hosts may react quite differently to a given parasite, one being stimulated to gall formation, while the other is not. It seems best for the present to include all the species in *Sorosphaera,* even though in some the tendency to form definite spore balls is much less evident than in the type species *S. veronicae* Schröter.''

A recent paper on this subject is the Taxonomy of the Plasmodiophoraceae by Palm and Burk (**14**). Their conclusions are based largely on a species of *Sorosphaera* on *Veronica americana* collected in Colorado. This species showed characters of *Sorosphaera, Sorodiscus, Ligniera, Clathresorus and Spongospora.* As a result of the studies they have suggested that *Spongospora, Ligniera, Sorodiscus, Ostenfoldiolla, Clathresorus* and *Membranosorus* should be made synonyms of *Sorosphaera.* The careful review that they have made of the subject appears to justify their suggestions. The writer is very much in sympathy with the suggestion. The organism under consideration does not fit exactly into any of the genera of Plasmodiophoraceae but it would fit into a genus Sorosphaera made to include the genera as suggested by Palm and Burk. The writer is of the opinion that this organism should be kept in the genus *Ligniera* or that there should be a merging of genera as suggested by Palm and Burk in which it would become *Sorosphaera vascularum.*

ECONOMIC IMPORTANCE

These studies have not given us as much data on this phase of the subject as we expected owing to the fact that we have not had the facilities for pursuing this phase of the work. All of the studies recorded in this paper have been made at the Experiment Station. Our knowledge of this phase of the subject may be summarized as follows,—

(1) It is more severe on some varieties than on others. It was very severe on D–109, a variety which is no longer in use on the island. It stopped the distribution of P. R. 801, a very promising new variety. Our knowledge of its relationship to other varieties is very meager.

A recent outbreak of the disease on first ratoon of FC 1017 showed an infection of about 20 per cent. This cane was growing in irrigated Vega Baja silt loam which is rather difficult to drain and there had been a heavy rainfall over a considerable period of time. The same variety growing in easily drained soil did not show any symptoms of the disease although it is possible that there may have been some infection.

(2) It is most severe in poorly drained soils. A variety that is severely attacked by this organism under these conditions may thrive in well drained soil. The cane growing in low areas in a field may be severely damaged by this fungus while the surrounding cane of

the same variety, but growing on higher land, may appear perfectly healthy. Cane growing on the higher levels may appear to be perfectly healthy but a careful examination may reveal the organism in some of the plants. On at least two occasions we have found that the cane in severely infected plantings was grown from cuttings that came from apparently healthy cane on well drained soil which upon examination showed the organism.

(3) The most important method of distribution from place to place is in the seed cuttings. It undoubtedly travels through wet soil from diseased to healthy plants, probably by zoospores which penetrate the roots.

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EXPLANATION OF FIGURES

1. Transition from plasmodium to spores. Nuclei appear with the formation of spores. (1 *b*).

2. Same. One old spore which did not germinate. The tracheary tube was cut oblique.

3. Cross section of tracheary tube showing formation of spores, one large spore which did not germinate, a spore with there nuclei which may indicate the formation of a quadrate, and surplus protoplasm.

4. Spore formation showing formation of quadrates.

5. Three large spores approaching maturity but both nuclei and inner bodies take the stain.

6. Three large spores kept in distilled water for 24 hours. The contents was moving rapidly, *a.* in one direction, *b.* in the opposite, *c.* showed a cell division and the contents of both halves were moving, *d.* showed three cell, was apparently a quadrate division, but there was no movement of the contents.

7. Germination of the resting spores by the formation of germ tubes and the transition of the zoospores into amoeboid stages.

8. The tracheary tubes and surroundings cells. Note the large spores in the tracheary tubes and in some of the small cells.

9. Two tracheary tubes. Note large spores in one and small spores in the other. Also small spores in small cells.

10. Tracheary tube surrounded by small cells. Note large and small spores in tracheary tube and small spores in surrounding cells.

11. Large and small spores in a tracheary tube.

12. Tracheary tube with large and small spores.

13. Part of tracheary tube and small cells. Both filled with small spores.

14. Two cells among fibrous cells, one with large and one with small spores. Note the thick walls.

15. Three cells among fibrous cells, one with plasmodium and two small spores. Note thick walls.

16. Small cells among fibrous cells, containing large spores. Note thick walls.

17. Three types of spores. The three large spores from one tracheary tube. The small spores of two sizes from another.

18, 19, 20. Large and small spores. Each group from a different tracheary tube.

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PLATE V

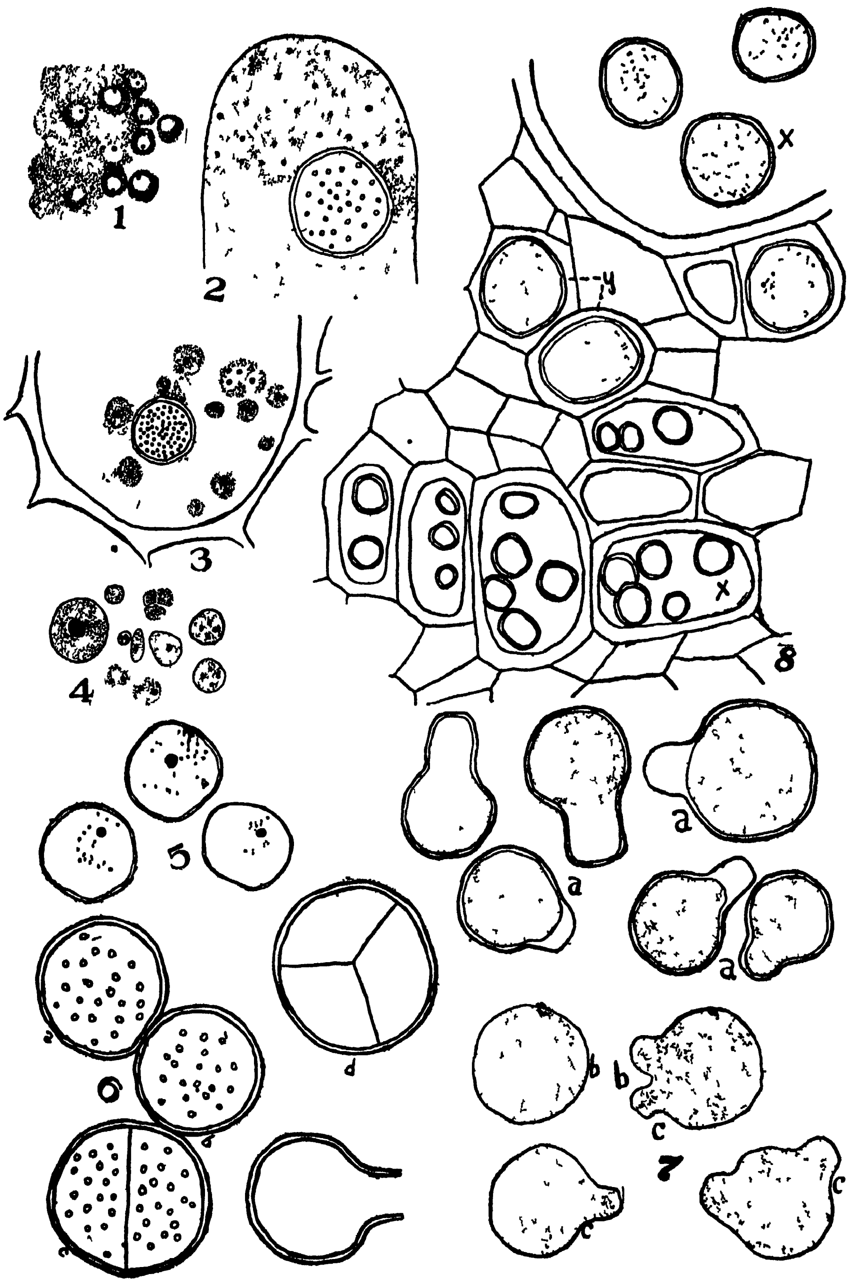
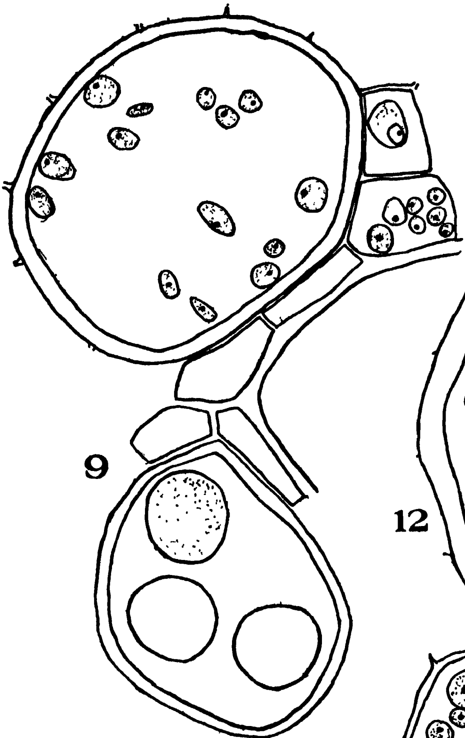


PLATE VI



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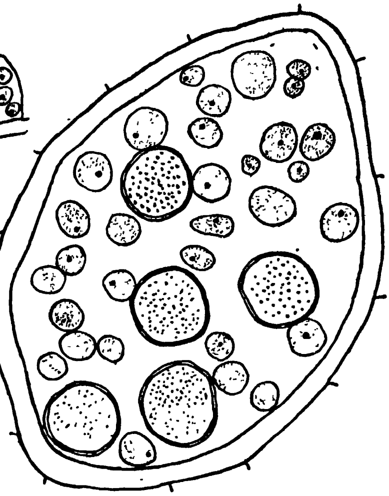

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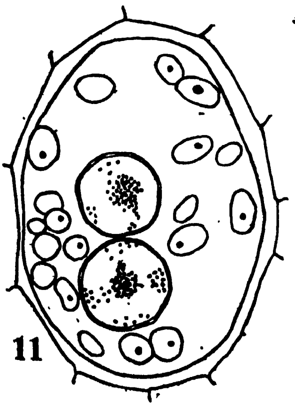

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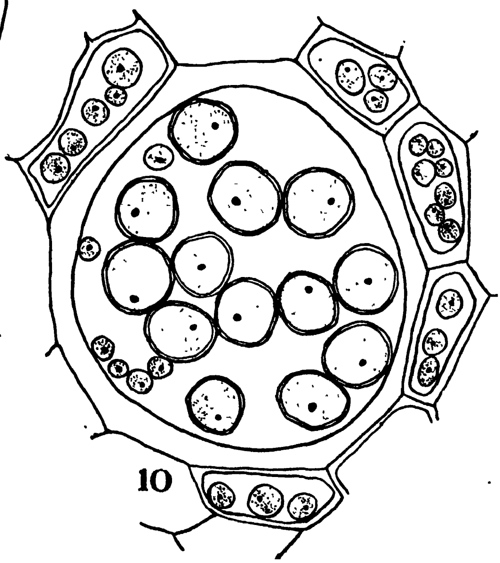

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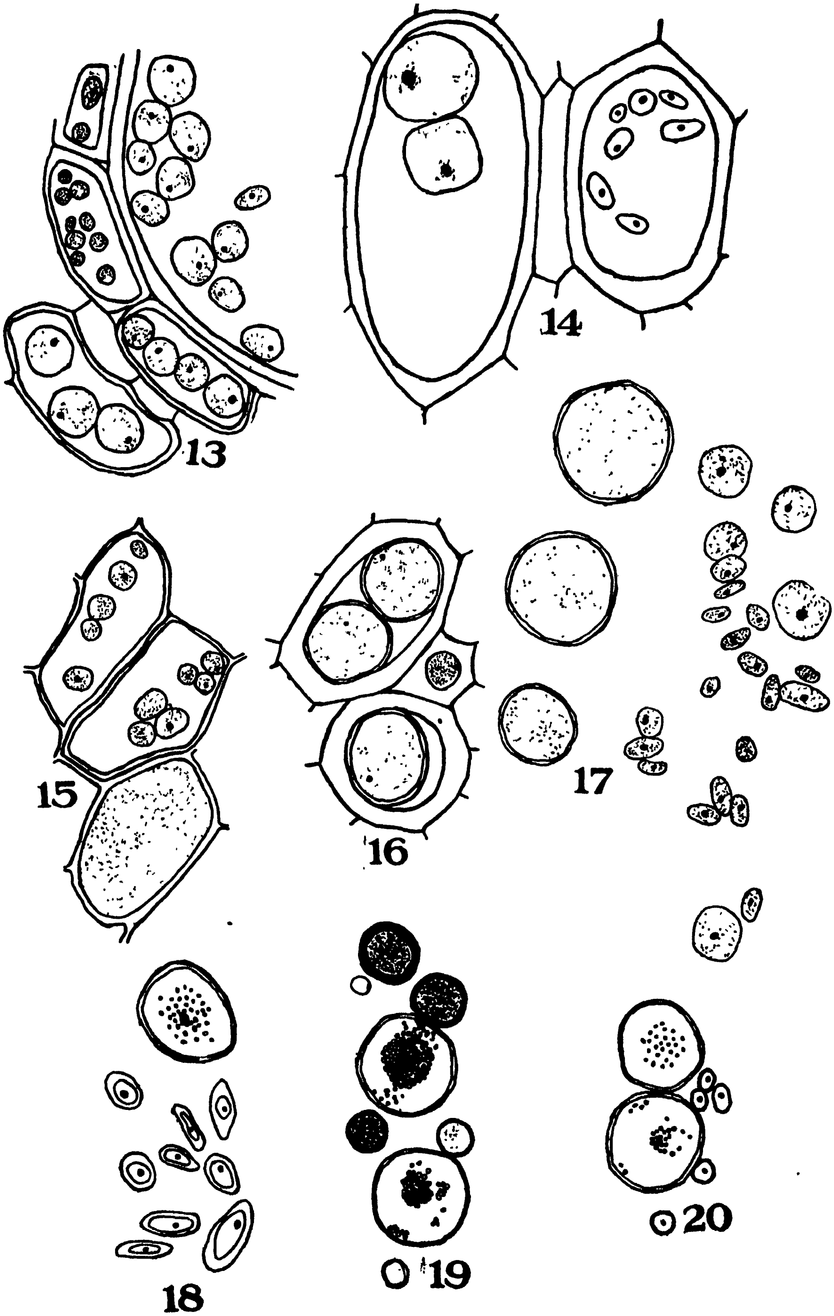
PLATE VII



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OBSERVATIONS ON SOME INSECTS ASSOCIATED WITH SUGARCANE IN PUERTO RICO

By F. M. WADLEY,
Associate Entomologist, Division of Cereal and Forage Insect Investigations, Bureau of Entomology and Plant Quarantine.

In connection with investigations carried on by the Bureau of Entomology and Plant Quarantine in Puerto Rico with special funds from August 1935 to June 1936 to obtain information on insects which transmit sugarcane diseases, surveys were made to secure data on the status and distribution of the insects in and around sugarcane fields, with special reference to those forms which feed on the juices of plants. The work was headquartered at the Federal Experiment Station at Mayagüez, which cooperated by supplying laboratory and other facilities and giving helpful suggestions and advice. This paper reports results of these surveys.

The sugarcane insects of Puerto Rico were listed by D. L. Van Dine (**10**) in 1913, with a review of earlier work. This list was supplemented by later observations on cane insects made by Jones (**4**, **5**), Smyth (**9**), Wolcott (**12**), and Seín (**7**). Wolcott has published a general list of Puerto Rican insects (**15**) and a textbook including chapters on cane insects of the West Indies (**14**). The cane insects of Santo Domingo have been listed by Wolcott (**13**) and those of Cuba by Van Dine (**11**). Insects in relation to cane mosaic in Puerto Rico have been discussed by several writers, especially Smyth (**8**). Chardon and Veve (**1**), and Seín (**6**).

In the present survey the greatest attention was paid to those sucking insects which might conceivably transmit mosaic disease. Three species were noted as occurring regularly on cane, viz, the yellow cane aphid, *Sipha flava* Forbes; the mealybugs, mostly *Trionymus sacchari* Ckll.; and the fulgorid *Saccharosydne saccharivora* Westw. Three additional aphids were carefully observed because these were occasionally found on cane or because they were suspected of transmitting mosaic disease. These were *Aphis maidis* Fitch, *Hysteroneura setariae* Thos., and *Carolinaia cyperi* Ainslie. Other

insects were observed incidentally, and observations were made on grasses which harbor some of these insects.

A few ecological details may be recorded for the benefit of those not familiar with Puerto Rico. The climate is tropical. The rainy season sets in late in the spring in most sections, reaches its height late in the summer or early in the fall, and declines late in the fall. The winter and early spring months comprise the dry season. This year (1935–1936) the drought was unusually pronounced, and the rainy season began suddenly at Mayagüez about May 1 with heavy and frequent rains. The north coast shows a moderate rainfall, 50 to 60 inches a year in many places. The interior mountains and the east, west, and northeast coasts have a high rainfall, 80 inches or more. The south coast has a comparatively low rainfall, 40 inches or less, and here cane is produced under irrigation. Nearly all the sugarcane is grown on the coastal plain or in valleys reaching toward the interior, practically none occurring in the central mountains. Some of the areas of most intensive cane culture are located in the southern irrigated part. The cane is harvested from January to May.

Two systematic extensive surveys of the cane-growing areas of the island were made, one in the fall of 1935, the other in the spring of 1936, the localities examined being indicated on the map (fig. 1). Other field observations were made occasionally, and an intensive survey was conducted at the experiment station at Mayagüez each month that other work permitted.

THE INTENSIVE SURVEY

The intensive survey at the experiment station included examination of cane varieties, grasses, and sedge. Six cane varieties, of some commercial importance, were growing in large replicated plats, and these were observed regularly; these were POJ 2878, M 28, M 63, FC 916, PR 803, and PR 807. Some small areas of old and new varieties were also available. Various grasses, *Panicum barbinode, Syntherisma, Capriola, Echinochloa colonum, Eleusine indica, Andropogon virgatus* (tent. det.), and *Cyperus rotundus* (a sedge), were common not only at Mayagüez but all over the island; while some other grasses occur but are less common. Corn is found growing at the experiment station at most times of the year. Over most of the island it is grown in small fields in either spring or fall. A small plot of sorghum grew at the experiment station, but this species is rare on the island.

The most noteworthy results of this survey are shown in table I.

TABLE I. RESULTS OF INTENSIVE SURVEY OF SUGARCANE INSECTS AT THE EXPERIMENT STATION AT MAYAGUEZ, P. R. 1935–36

Insect	Plant	Percentage infested in month of— August	Nov.	Dec.	Jan.	Feb.	March	April	May	June
Aphis maidis	Corn, tasseled	some	26	26	14	15	20	8	40	...
	Sorghum	some	82	54	58	26	48	16	52	66
	Panicum barbinode, field	few	1–	3	1–	0	1	0	1	...
	Panicum barbinode, moist ditch	...	...	...	...	8	8	6	2	...
	Echinochloa colonum		3	4	0	0	0	0	8	...
	Sugarcane	very few	0	0	0	0	0	0	1–	0
Hysteroneura setariae	*Eleusine indica*	few	4	7	12	8	8	19	3	0
	Panicum barbinode	...	0	1	6	1	9	1	5	...
	Syntherisma	...	0	6	4	11	2	3	0	...
	Echinochloa colonum	...	2	8	4	8	2	0	0	...
	Sugarcane	0	0	0	0	0	1–	0	1–	0
Sipha flava	Sugarcane	many	8	6	14	15	34	65	57	11
	Chaetochloa setosa	...	18	10	10	4	16	22	12	...
	Syntherisma	...	1	0	1	1	4	2	5	...
Carolinaia cyperi	*Cyperus rotundus*	...	25	10	28	21	1	1–	0	0
Saccharosydne saccharivora	Sugarcane	few	1	1–	1–	2	1–	1–	1–	0
Mealybugs	Sugarcane	some	10	27	35	43	some	some	12	...
	Sorghum	...	42	74	70	(cut)	some	40	36	...

(In most cases the stalk or stem was the unit counted; in the cases of *Eleusine* and *Cyperus* the whole plant was the unit taken. Most of the percentages for sugarcane represent several hundred units; from 50 to 100 samples of other plants were examined.)

The results of the survey on a number of cane varieties were recorded separately, but these details are omitted for the sake of brevity. Only a few varietal differences were encountered. The cane variety POJ 2878 had heavier mealybug infestations than other varieties, PR 803 showed somewhat greater populations of *Sipha flava* than others, and the unimportant variety M 505 was outstandingly susceptible to *Sipha flava*.

Mosaic disease was not an important factor around Mayagüez, since nearly all cane grown there was of highly resistant varieties. The few small areas of susceptible varieties seen were considerably infected, and mosaic-like symptoms were noted on crabgrass and sorghum. Sugarcane borers (*Diatraea* sp.) were present at all times, but onty in moderate numbers; the variety PR 807 was most consistently infested.

Mealybugs (*Trionymus sacchari*) seemed rather scarce on young cane, and were difficult to find without uprooting the plants. On older cane they were more numerous and located higher on the plants, under the sheaths. Dead mealybugs covered with fungus were sometimes seen, especially in rainy weather. *T. sacchari* was also found on sorghum. Another mealybug, *Pseudococcus brevipes* Ckll., was seen occasionally on crowns of *Panicum barbinode, Eleusine indica* and *Cyperus,* and once on corn. Root insects were not included in the survey.

In addition to these records, *Aphis maidis* was seen occasionally on untasseled corn, a few times on *Coix lachryma-jobi, Pennisetum purpureum,* and *Gynerium sagittatum,* and once on *Chaetochloa setosa* and *Cyperus.* Only migrants of this aphid were seen on cane in the field, though at one time a colony occurred in a cage. The species was usually found on heads or terminals of plants, but sometimes on the leaves. It was found in greater numbers in cages or sheltered places than in the open. When numerous, *A. maidis* was attacked by parasites and predators. Parasites reared included *Lysiphlebus testaceipes* Cress., *Pachyneuron siphonophorae* Ashm., and *Tetrastichus marylandensis* Gir. Predators included coccinellids and syrphids.

Hysteroneura setariae was found in small numbers a few times on *Paspalum conjugatum, P. paniculatum* (tent. det.), *Capriola dactylon, Panicum reptans* (tent. det.), *Andropogon virgatus* (tent. det.). *Sporobolus virginicus* (tent. det.), and *Gynerium sagittatum.* It was nearly always found on the heads of grasses, although sometimes stems or leaves were colonized, especially on *Eleu-*

sine. Colonies occurred on cane (on the auricle) in southern Puerto Rico, but not at Mayagüez. When abundant, this aphid was attacked by parasites, predators, and under damp conditions by a fungus (*Acrostalagmus aphidum* Oud.) Parasites reared included *Lysiphlebus testaceipes, Pachyneuron siphonophorae,* and *Aphidensyrtus aphidivorus* Mayr.

Sipha flava occurred on the leaves of its food plants, a reddish discoloration being associated with its feeding. Besides the plants noted in table I it was found a few times on *Panicum barbinode, P. maximum, Eleusine indica, Echinochloa colonum, Paspalum conjugatum,* and *P. paniculatum* (tent. det.), and one migrant was observed on corn. The species occurred on grasses in small numbers, but sometimes became numerous and injurious on sugarcane, 400 individuals once having been found on a single leaf. It was attacked by predators and a fungus (*Acrostalagmus*), but parasites were not seen in this work. Predators observed were a few syrphids and some coccinellids, including *Cycloneda Sanguinea* L. and a small black species.

Carolinaia cyperi was seen only on *Cyperus,* usually in small numbers, and no insect enemies were observed. *Saccharosydne saccharivora* was usually seen only on cane, but was once swept from grass, mostly *Panicum barbinode.*

Numerous other insects were encountered. Several aphid migrants, not yet determined, occurred on cane in May; some seemed to be from nearby citrus. Leafhoppers and fulgorids were frequently found on cane and grasses, but seemed in most cases to be transients. *Cicadella similis* Walker on *Panicum barbinode* and other grasses, *Delphacodes* sp. on *Echinochloa colonum, Peregrinus maidis* Ashm. on corn, and *Phaciocephalus cubanus* Myers on cane were especially noted. *Nesostelus incisus* Mats. was swept from grass, mostly *P. barbinode; Typhlocybella minima* Bak. and *Empoasca* sp. were swept from *Bradburya;* and *Empoasca* from indigo. Chinch bugs (*Blissus leucopterus* var. *insularis* Barber) occurred on grasses a few times. Ants, principally the fire ant, attended aphids, and were especially active around mealybugs. Snout beetles, caterpillars, scales, psocids, thrips, mites, and other organisms were noted in small numbers. *Chirotrips mexicanus* Crawf. was repeatedly noted in heads of *Eleusine indica.*

Aphids were determined by P. W. Mason, mealybugs by Harold Morrison, aphid parasites by A. B. Gahan, leafhoppers and fulgorids by P. W. Oman and H. L. Dozier, thrips by J. C. Crawford, and the fungus by Vera K. Charles.

THE EXTENSIVE SURVEY

The first extensive survey was conducted in September and October 1935, late in the rainy season. The cane at this time was of medium to large growth. A field was selected at random in each of the 34 localities marked on the map (fig. 1). In each field 100 stalks were examined in 5 samples of 20 each, well distributed through the field. The results appear in Table II.

Insects were found much as recorded for the intensive survey. The borer *Diatraea saccharalis* F. was widespead and often injurious; it seemed somewhat more numerous in the south than elsewhere. *Hysteroneura setariae* occurred on *Eleusine* near Aguadilla, Río Grande, Naguabo, Fajardo, Patillas, and on *Gynerium* at Guánica. *Aphis maidis* occurred in small numbers on *Panicum barbinode* near Isabela, Guayama, Naguabo, Fajardo; on *Gynerium* at Guánica; on corn near Loíza, Fajardo, Hatillo, Arecibo, Naguabo, Dorado, Isabela, and Juana Díaz; and on *Pennisetum* (elephant grass) near San Germán. *Sipha flava* was recorded once on corn, once on crabgrass, and once on an unknown grass.

The second extensive survey was conducted in March and April 1936, toward the end of an unusually severe dry season. Some fields were still unharvested, with stalks of large growth and dry lower leaves (classes as "large" in Table III). Some were fall-planted, of medium growth (rather large when irrigated, as in the south). Some were of new ratoon growth and rather small. Sampling was conducted as in the fall survey and approximately the same localities were selected, except that the one in San Sebastián and one in Cabo Rojo were omitted. The results appear in Table III.

Other insects were noted much as in the fall survey and the intensive survey. *Diatraea saccharalis* was widespread and somewhat injurious in places. It was more abundant in southern Puerto Rico and less abundant on the west coast than elsewhere. Little difference in its numbers could be noted between varieties or seasons. Chinch bugs were found once on a single stalk of cane at Humacao.

Aphids found on nearby plants included *Aphis maidis* on corn at San Germán and on *Panicum barbinode* at Guánica, Caguas, and Guayama. *Hysteroneura setariae* occurred on *Eleusine* at Carolina, Yabucoa, Guayama, Santa Isabel, and San Lorenzo; and on *P. barbinode* at Rincón, Arecibo, and Yabucoa. *Carolinaia* occurred on *Cyperus rotundus* near Arecibo, Dorado, Ponce, Peñuelas, Yauco, and San Lorenzo.

TABLE II. RESULTS OF EXTENSIVE FALL SURVEY OF SUGARCANE INSECTS IN PUERTO RICO, 1935

Section	Locality	Variety of cane	Percentage of stalks with—						Aphids on nearby plants
			Mealybug	*Saccharosydne saccharivora*	*Sipha flava*	*Hysteroneura setariae*	*Aphis maidis*	Mosaic	
West coast	Cabo Rojo (1)	POJ 2878	64	10	2	0	0	0	
	Cabo Rojo (2)	M 28	24	13	36	0	0	0	
	Cabo Rojo (3)		41	1	1	0	0	0	
	Mayaguez	POJ 2878	21	11	8	0	0	0	See table I
	Rincón	POJ 2878	17	11	25	0	0	0	
	Aguadilla	POJ 2878	74	6	11	0	0	0	*Hysteroneura setariae*
North coast	Isabela	M 28	19	5	11	0	0	0	*Aphis maidis*
	Hatillo	POJ 2878	47	5	4	0	0	0	*Aphis maidis*
	Arecibo	POJ 2878	32	16	0	0	0	1	*Aphis maidis*
	Manatí	POJ 2878	57	12	17	0	0	0	*Aphis rumicis*
	Dorado	PO. 2878	39	3	1	0	0	1	*Aphis maidis*
	Carolina	SC & BH	20	23	8	0	0	6	
	Río Grande	SC 12-4	46	1	25	0	0	0	*Hysteroneura setariae*
East coast	Fajardo	BH 10-12	40	5	17	0	0	0	*Hysteroneura set.*,
	Naguabo	BH 10-12	29	3	9	0	0	21	Do. *Aphis maidis*
	Humacao	BH 10-12	24	13	28	0	0	0	
	Yabucoa	BH 10-12	4	7	11	0	0	1	
South coast	Guánica	BH 10 12	15	4	16	6	0	0	*Hysteroneura setariae*,
	Peñuelas	BH 10-12	20	5	4	0	0	0	*Sipha flava*,
	Ponce	BH 10-12	6	1	34	4	0	1	*Aphis maidis*
	Santa Isabel	BH 10-12	54	11	3	0	0	3	
	Guayama	BH 10-12	17	4	0	6	0	0	*Aphis maidis*
	Patillas	BH 10-12	32	4	18	0	0	0	*Hysteroneura setariae*
Interior valleys	San Sebastián	POJ 2878	47	12	2	0	0	0	
	Añasco	PO. 2878	24	1	5	0	0	0	
	Quebradillas	POJ 2878	45	17	9	0	0	1	
	Barceloneta	POJ 2878	18	4	19	0	0	1	
	Caguas	SC 12-4	55	9	9	0	0	37	
	San Lorenzo	SC 12-4	59	12	4	1	0	37	
	Loíza	BH 10-12	15	2	15	0	0	6	*Aphis maidis*
	Juana Díaz	BH 10-12	37	5	38	0	1	0	*Aphis maidis*, *Sipha*
	San Germán	POJ 2878	43	14	23	0	0	0	*Aphis maidis* *flava*
	Yauco	BH 10-12	60	0	7	0	0	1	
	Lajas	BH 10-12	66	1	0	0	0	0	

TABLE III. RESULTS OF EXTENSIVE SPRING SURVEY OF SUGARCANE INSECTS IN PUERTO RICO, 1936

Section	Locality	Variety of cane	Growth	Percentage of stalks with— Mealybug	*Saccharosydne saccharivora*	*Sipha flava*	*Hysteroneura setariae*	*Aphis maidis*	Mosaic	Aphids on nearby plants
West coast	Cabo Rojo (1)	POJ 2878	Small	0	0	31	0	0	0	
	Cabo Rojo (2)	POJ 2878	Small	16	3	29	0	0	0	
	Mayagüez	POJ 2878	Medium	22	8	64	0	0	0	See table I
	Rincón	M 28	Medium	25	2	37	0	0	0	*Hysteroneura setariae*
	Aguadilla	M 28	Medium	5	5	5	0	0	0	
North coast	Isabela	M 28	Small	0	2	4	0	0	0	
	Hatillo	M 28	Small	6	1	2	0	0	0	
	Arecibo	BH 10-12	Medium	16	2	33	0	0	6	*Hysteroneura setariae,*
	Manatí	M 28	Small	1	56	42	0	0	0	*Carolinaia*
	Dorado	M 28	Medium	15	3	5	0	0	1	*Carolinaia*
	Carolina	SC 12-4	Large	41	0	11	0	0	4	*Hysteroneura setariae*
	Río Grande	POJ 2878	Large	91	0	8	0	0	0	
East coast	Fajardo	BH 10-12	Medium	11	1	1	0	0	0	
	Naguabo	BH 10-12	Small	6	1	12	0	0	0	
	Humacao	BH 10-12	Medium	31	2	18	0	0	0	
	Yabucoa	BH 10-12	Medium	8	0	0	0	0	0	*Hysteroneura setariae*
South coast	Guánica	BH 10-12	Medium	32	1	0	0	0	0	*Aphis maidis*
	Peñuelas	BH 10-12	Medium	2	2	37	3	0	30	*Carolinaia*
	Ponce	BH 10-12	Medium	7	4	22	0	0	0	*Carolinaia*
	Santa Isabel	BH 10-12	Medium	4	1	8	0	0	0	*Hysteroneura setariae*
	Guayama	BH 10-12	Medium	0	1	40	0	0	0	*Hysteroneura setariae,*
	Patillas	BH 10-12	Medium	39	4	17	0	0	3	*Aphis maidis*
Interior valleys	Añasco	POJ 2878	Large	70	2	8	0	0	0	
	Quebradillas	M 28	Large	65	5	19	0	0	0	
	Barceloneta	FC 916	Medium	14	21	19	0	0	0	
	Caguas	POJ 2878	Small	0	1	22	0	0	0	*Aphis maidis*
	Loíza	BH 10-12	Medium	4	1	5	0	0	20	
	San Lorenzo	POJ 2878	Large	73	1	4	0	0	0	*Hysteroneura setariae,*
	Juana Díaz	POJ 2878	Large	93	1	4	0	0	0	*Carolinaia*
	San Germán	SC 12-4	Large	33	1	4	0	0	28	*Aphis maidis*
	Yauco	Co 281	Small	15	0	0	0	0	0	*Carolinaia*
	Lajas	"Jap"	Small	1	0	0	0	0	0	

Discussion

Mealybugs, often in large numbers, were found wherever search was made on cane. Wet weather appears to be unfavorable to them. The mealybugs are hard to find on young, small cane, but they seem to be come very abundant on cane that is old and has nearly stopped growing. Hence they are numerous in unharvested fields in the dry season. They were somewhat more numerous on POJ 2878 than on other varieties. While these insects do not receive much consideration, they may cause more injury than is generally suspected. Their work is not conspicuous.

Sipha flava was also widespread, and in the spring was somewhat more numerous in western Puerto Rico than in other parts of the island. It became more abundant in dry weather, but wet weather was not unfavorable enough to keep it from maintaining numerous small colonies. It became locally injurious near Cabo Rojo following a short dry spell in August 1935 and was somewhat injurious over wide areas in the spring of 1936. It seemed to favor certain varieties, but little preference was shown among the more important ones. It appears to be among the minor problems of cane growing.

Saccharosydne saccharivora was widely present, but nearly always in small numbers. In the fall it was less abundant in the dry south-coast country than elsewhere, and in the spring it was generally less abundant than in the fall. Thus on the whole it seems that dry conditions were not favorable; but in the one field, where it was very abundant, dry conditions prevailed (Table III, Manatí). It did not appear to do much injury.

Aphis maidis was more abundant in the rainy than in the dry season. This may be ascribed to the better condition of the food plants. It was seldom found on cane. It was present on some grasses in widely scattered localities, but only in small numbers. Sorghum is a favorable but rare host. The only host that supported large populations over any considerable area was tasseled corn. According to observations of Mr. B. A. App and the writer, *Aphis maidis* occurred on corn all over the island, but corn was not abundant in the areas of the south and east coasts, where cane is grown as the almost exclusive crop. Corn was found growing close to cane most often in areas of diversified farming.

Hysteroneura setariae occurred in small to moderate numbers on grasses all over Puerto Rico, and in limited numbers on cane (BH 10–12) along the south coast. It was rarely seen on cane elsewhere

The colonies on cane were on the auricles, as has been observed in Louisiana. It was not seen on BH 10–12 in sections other than the south coast, and was once observed in the southern region in a field of SC 12–4. Hence the difference in distribution seems to be regional rather than varietal and may be ascribed to low rainfall and the favorable growth of irrigated cane. The species was much more abundant in dry than in rainy weather.

Carolinaia cyperi was found in a number of places in small or moderate numbers, and was seen only on the common sedge, *Cyperus rotundus*. It was more abundant in dry than in rainy weather, except when its food plant was injured by drought. It persisted at some points in the dry region in May, after rains had set in at Mayagüez and it could no longer be found there.

Tables II and III show the susceptibilty of the cane varieties SC 12–4 and BH 10–12 to mosaic, and its almost complete absence in other important varieties. The resistant varieties have almost entirely replaced the susceptible ones in the west, and have largely replaced them on the north coast and in interior valleys. In the south and east BH 10–12 is still widely planted. Jensen (3) finds that the spread of mosaic disease is rapid in the west, north, and interior and slower in the south. He observes that it is more rapid near hills and pastures and less rapid near the sea and in areas solidly planted to cane. In the areas of rapid spread, fields of susceptible varieties are often heavily infected, though control by roguing sometimes gives fair results. In areas of slow spread control by roguing is usually successful, though infected fields occur.

The areas of slow or rapid spread must be marked by scarcity or abundance of vectors, respectively. Mealybugs are numerous in both areas, and hence do not seem likely to be a vector; the same is true, to an extent, of *Saccharosydne saccharivora*. The yellow aphid *Sipha flava* also occurs throughout the island and experiments in transmission with this aphid under this project have been negative. In the same experiments *Hysteroneura setariae* and *Carolinaia cyperi* have shown ability to transmit mosaic. It is doubtful whether they are of much importance in field transmission, because they are at least as numerous in areas of slow spread as in areas of rapid spread. *Aphis maidis* seems more likely to be important in field transmission, because of the evidences mentioned of its greater abundance in the areas of rapid mosaic spread in the west, north, and interior than in the areas of slow spread. Another possibility in field transmission is that aphids having no association with grasses might trans-

mit mosaic by temporary feeding on cane in the course of migration. A situation of this sort was found in connection with a disease of onion (Drake, Harris, and Tate (2)). Such aphids have been taken on cane at Mayagüez, and in one case positive transmission was secured with a species not normally found on grasses. Rapid mosaic spread shows a strong association with diversified plant growth, which is probably accompanied by an abundance of vectors.

SUMMARY

Survey work in 1935–36 on sugarcane insects of Puerto Rico, especially those which may transmit mosaic disease, is described. Previous work is cited; climate, geography, and methods are outlined briefly.

Aphis maidis was found to be rather abundant on tasseled corn, sparingly present on several grasses, and scarce on cane. *Hysteroneura setariae* was moderately abundant on some grasses, occasional on cane along the south coast, and rare on cane elsewhere. *Sipha flava* was widespread on cane, sometimes injurious, and small numbers occurred on grasses. *Carolinaia cyperi* was found in moderate numbers on a sedge. *A. maidis* was most numerous in the rainy season, the other three in the dry season. Mealybugs were numerous, especially on mature cane. *Saccharosydne saccharivora* was widespread but seldom numerous on cane. Some minor insect notes are recorded.

Aphis maidis seems likely to be important in mosaic dissemination, because more abundant in areas of rapid than of slow spread. *Hysteronera* and *Carolinaia* seem less likely to be important, and the other insects named seem unlikely to be implicated at all. Some aphids not breeding on grasses may be important.

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NOTES ON THE CHANGA, OR WEST INDIAN MOLE CRICKET, IN PUERTO RICO IN 1935 AND 1936

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Introduction

A study of the changa (*Scapteriscus vicinus* Scudd.) was conducted in Puerto Rico in 1935 and 1936 by the Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, in cooperation with the Puerto Rico Agricultural Experiment Station at Mayagüez. During this period changa damage was apparently not so severe as it has been in the past, according to the observations of previous workers. This was perhaps partly due to the severe drought which extended over practically the entire Island during part of this period, for although this drought occurred during the normal dry season it exceeded in severity those of all previous Weather Bureau records covering a period of 25 years. Under such conditions changa damage is normally much less severe.

Sugarcane comprises approximately 35 percent of the entire marketable crops produced on the Island and a much larger proportion of the crops susceptible to changa damage. Although repeated observations were made in the sugarcane fields over the entire Island, however, in only a few instances was any appreciable changa damage noted. Damage to coffee, the second largest crop, was limited to a few slight infestations occurring in seedling beds. Tobacco, ranking third as an economic crop, is considered one of the favorite host plants of the changa, but there was no important damage to this crop, and the heaviest infestation was that observed in a small field of approximately three-fourths of an acre in which 10 percent of the plants had been destroyed. The only cases of severe damage were confined to minor crops such as sweet corn and vegetables, several cases having been observed in which from 50 to 98 percent of the crop was destroyed. In practically all of these cases, however, the planting did not exceed 1 acre and the resulting commercial loss was therefore relatively slight.

A part of the popular belief existing on the Island concerning the seriousness of the changa problem is doubtless due to the fact

that a considerable amount of damage caused by other insects is attributed to the changa. Damage by white grubs and cutworms is often confused with changa damage, and cases have come to the writer's attention in which chinch bugs, millipedes, and even fungus diseases, were causing the reputed changa injury.

Distribution

Distribution limited to definite areas of the Island.—One of the main purposes of this project was to determine the limits of distribution of the changa on the Island. This was accomplished by making extensive surveys over practically the entire area. This insect was found to occur in the following localities: Aguirre, Añasco, Arecibo, Arroyo, Bejuco, Cabo Rojo, Caguas, Carolina, Cayey, Corozal, Florida, Guayama, Hormigueros, Humacao, Isabela, Lajas, Las Marías, Loíza, Maleza Baja, Maricao, Mayagüez, Pueblo Viejo, Río Piedras, Quebradillas, and Yabucoa. Since practically all of these points are around the coast or within the interior river valleys, the observations indicate that the distribution of this insect is limited to such areas. Other workers on the changa in Puerto Rico have reached similar conclusions.

Type of soil the chief factor limiting distribution.—Such factors as elevation, temperature, and distribution of host plants appear to have little or no effect on distribution. Abundance of rainfall seems to be of some importance, there being apparently more changas in the areas receiving the greatest amounts of precipitation. The chief factor limiting distribution is undoubtedly the type of soil. Distribution is quite definitely limited to light-textured, sandy soils. These soils are particularly adapted to the burrowng activities of the changa and thus afford the most suitable environment. In heavy clay soils, the insect is either very rare or entirely absent. Unfortunately, soils best suited to the growing of vegetables and similar crops are the only soils inhabited to any great extent by the changa; consequently damage to such crops is particularly heavy unless control measures are employed.

Host Plants

The changa feeds upon a wide range of host plants. Feeding has been observed by the writer on the following: Basil (*Ocimum basilicum*), bean, cabbage, coffee seedlings, young cotton plants, cucumber, eggplant, sweetpotato, tobacco, and various grasses. Only plants showing visible evidence of feeding on the stem at the crown were

included in this list. Severe injury is caused in this manner and usually results in the destruction of the plant. Other workers on the Island report the changa as feeding upon the following, in addition to the plants in the foregoing list: Cantaloup, collard, onion, pea, rape, rice, turnip, *Colsus* spp., and *Livingstonia* spp. In fact, almost any young plant may serve as food, although plants having a poisonous or acrid sap are said to be avoided.

The writer's cage studies and field observations have shown that the changa feeds also to a considerable extent on decomposing organic matter in the soil, and it has been found that it feeds upon its own and other species of insects.

Damage

Damage to plants by the changa results mainly from its feeding activities, but some damage results from the uprooting of the seedling plants caused by movements of the changa through the soil. Feeding is confined entirely to the roots and stems, usually at the crown in the latter case. Stems are either completely severed or are so badly gnawed that they are no longer able to support the weight of the plant. Obviously, the greatest amount of damage results from this type of feeding, since injury to the stem usually causes the loss of the entire plant.

The greatest damage normally occurs after heavy rains or after the soil has been moistened by irrigation. This is because the changa is active at the surface only when the soil is sufficiently softened by moisture to permit such activity, and it is at such times that feeding upon stems occurs. Since feeding on the roots of plants produces little appreciable damage, it is apparent that the most injury can take place only under the above conditions. In general, the greatest amount of damage may be expected during the rainy season.

Natural Enemies of the Changa

A number of native birds are known to be of value in preying upon the changa. These have been recorded by Wetmore (U. S. Dept. Agr. Bul. 326, 1916). The more important of these are listed here in the order of their importance:

Martinete, or green Cuban heron	*(Butorides virescens maculatus)*
Falcón, or Puerto Rico sparrow hawk	*(Falco sparverius loquaculus)*
Playero, or Antillean killdeer	*(Oxyechus vociferus rubidus)*
Putilla, or spotted sandpiper	*(Actitis macularia)*

Garza, or little blue heron	*(Florida caerulea)*
Judio, or smooth-billed ani	*(Crotophaga ani)*
Ruiseñor, or Jamaican mocking-bird	*(Mimus polyglottos orpheus)*
Clérigo, or Puerto Rico petchary	*(Tolmarchus taylori)*
Pitirre, or gray kingbird	*(Tyrannus dominicensis dominicensis)*
Juí, or Antillean flycatcher	*(Myiarchus antillarum)*
Garzón blanco, or American egret	*(Casmerodius albus)*

These birds should receive every possible protection.

A few minor enemies, such as ants, spiders, and lizards, have been recorded, but these are relatively unimportant.

Observations have been made which indicate that the giant toad (*Bufo marinus*) is an important enemy of the changa. This animal was first introduced into the Island in 1920 and it appears to have been playing a considerable part in the control of the changa since that time. An examination of the stomachs of a small number of these toads during the latter part of 1935 revealed that the changa comprised about 15 percent of the stomach contents. This, however, is probably not a true indication of the extent to which they are preyed upon by the toad, because, owing to the dry condition of the soil, changas were not very plentiful at the time.

Good Control by Poisoned Baits

Satisfactory control of the changa can be obtained by the use of poisoned baits. The bait formulated by Crossman and Wolcott in 1915 is extensively used on the Island and is fairly efficient. It consists of a mixture of paris green and flour, the proportion of paris green being from 3 to 10 percent of the total mixture. Three percent of paris green is usually sufficient.

The bait should be broadcast over the field at the rate of 300 pounds per acre about one week before planting. This should be done as late in the afternoon as possible, preferably after a rain, since the best results are obtained when the surface of the soil is wet. In cases of severe infestation a second application may be necessary, and this also should be made prior to planting, since it is very difficult to apply this bait broadcast in a field containing growing plants and avoid burning them. The bait may also be applied around individual plants. In this case, shallow trenches are first made around each plant and a small quantity of bait is placed around the bottom of each trench. Applications of this type require only about

150 pounds of bait per acre, but all other conditions mentioned above should be observed.

Some work was completed which indicated that the substitution of wheat bran for flour increased the efficiency of the bait. This should first be mixed thoroughly with the paris green and then the mixture should be moistened with water until a handful of the mixture will no longer fall apart or break up after being compressed, but not enough water should be added so that any moisture can be extracted in this way. Applications can be made in the same manner as described above.

Other Methods of Chemical Control of Some Value

It was found that a mixture of 8 ounces of pyrethrum powder to 2 gallons of water, when poured over the surface of the soil, kills the changas immediately below the surface. This method of control should be used only when the soil is wet; and since the cost of the material is high, its use is restricted to special cases where the cost is justifiable.

A strong solution of blue soap (the common laundry soap obtainable anywhere on the Island) and water when used as above is of considerable effectiveness. This mixture should be poured into individual burrows if possible. It should be applied at an early hour in the morning when the changas are near the surface in the fresh burrows made the preceding night. All changes driven to the surface may be readily collected and killed. With this treatment killing is necessary since the action of the soap and water renders the mole crickets inactive for only a short time.

Summary

Distribution of the changa is limited to the coast and to the interior river valleys of the Island. Type of soil is the chief factor limiting distribution.

A wide variety of host plants are attacked, but a slight preference appears to be shown for certain plants.

The main damage results from feeding, which is confined to the roots and stems of plants. The greatest damage occurs when the surface of the soil is wet.

Few, if any, important natural enemies of the changa, other than birds, are native to the island, although the introduced giant toad seems to be proving a valuable aid in control.

Poisoned baits afford a satisfactory means of control, and other means of chemical control may be employed.

DESCRIPTIONS OF MISCELLANEOUS CHALCIDOID PARASITES FROM PUERTO RICO. (HYMENOPTERA)

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During the course of recent entomological investigations in Puerto Rico advantage was taken of the opportunity to collect for study certain groups of small chalcid wasps. The present paper gives descriptions of thirteen new species from Puerto Rico, together with three additional species from other localities. Rearing records of four previously described but little known encyrtids are also given. Most of the parasites treated in this paper are either coccid-inhabiting or parasitic in the eggs of other insects. One is an important larval parasite of the Cuban laurel thrips, *Gynaikothrips uzeli* (Zimm.).

FAMILY ENCYRTIDAE

Leptomastidea antillicola, new species

Easily distinguished from all described members of the genus by the difference in wing markings and male genitalia.

Male.—Length, exclusive of oedeagus, 1.075 mm., expanse 2.137 mm., greatest width of forewing 0.358 mm.

General color yellowish, the head and prescutum a soiled orange, the pronotum fuscous; the scutellum, metanotum, propodeum, and abdomen embrowned. Eyes greenish. Antennae brown, the scape paler along inner margin at base. Forewings hyaline, with the marginal vein and the stigma brown, and a short, prominent, oblique brown vitta extending from the marginal vein basally but not reaching the posterior margin; an irregular fuscous clouding extending across the apex and following around the posterior margin for over half its length. Legs a soiled testaceous, the posterior ones distinctly darker.

Head slightly narrower than the thorax. Frontovertex appearing polygonally reticulate under high magnification. Eyes prominent, distinctly hairy. Antennae slightly longer than the body, the scape and pedicel reticulated; the scape slightly compressed, almost four times as long as wide, greatest width at the middle; pedicel short, only a fourth as long as the scape, narrowed at base; funicle with verticillate whorls of long cilia, joints 3–6 provided with inconspicuous longitudinal sensoria; first funicle joint slightly longer than the others, but distinctly shorter than the club. Pronotum very short. Prescutum rather short, nearly two and a half times as wide as long, covered with numerous

black setae. Scutellum triangular, rounded at apex, provided with strong setae, and appearing scaly reticulate under high magnification. Forewings comparatively broad, measuring 0.860 mm. in length by 0.359 mm. in width, densely ciliate except for a somewhat oval and oblique bare area beneath the marginal vein. Abdomen subovate, slightly longer than the thorax. Male genitalia long and slender, without lateral process; claspers with a pair of short, small spines.

Female.—Unknown.

Type.—Cat. No. 51762, U. S. National Museum.

Described from a single male reared by Dr. M. R. Smith from *Pseudococcus virgatus* on foliage of "Guaba", *Inga inga,* in coffee grove of the University of Puerto Rico Demonstration Farm at San Sebastián, P. R., May 12, 1936.

Anagyrus similis, new species

In general appearance and antennal coloration this species is close to *Anagyrus coccidivorus* Dozier and *A. subalbipes* Ishii but is differentiated from those at once by its black head, pronotum, and prescutum.

Female.—Length 1.46–1.58 mm., expanse 2.27–2.44 mm., greatest width of forewing 0.35–0.37 mm. Head opaque black; pronotum and prescutum black, the remainder of the thorax a soiled orange. Antennae white, the basal half of the pedicel and the entire first funicle joint black and the scape black, marked with a conspicuous pale area occupying the distal fourth, this pale area yellowish on the dorsal half and clear transparent on the ventral half. Abdomen light brown; the legs a soiled testaceous-yellow.

Eyes covered with numerous short, erect, dark, setae. Mandibles bidentate, the lower tooth smaller. Antennae very long and slender, 0.90 mm. in length, covered with numerous short hairs, the scape conspicuously widened or foliaceous, twice as long as greatest width, covered with numerous strong setae, particularly prominent over the pale distal area; funicle joints distinctly longer than wide, funicle 1 the longest funicle joint and subequal to the pedicel in length; funicles 2–4 subequal in length and very slightly longer than funicles 5 and 6. Forewings 1.00 mm. in length and 0.37 mm. in width, rather uniformly ciliated except the oblique hairless streak. Abdomen distinctly longer than the thorax, narrowed to the tip, the ovipositor hidden.

Male.—Unknown.

Type.—Cat. No. 51742, U. S. National Museum.

Described from the type female taken by the writer sweeping roadside grass and vegetation at Santa Isabel, P. R., Aug. 16, 1935; a paratype female taken sweeping grass on dry pastured slopes near San Germán, P. R., November 26, 1935; and a paratype female taken sweeping "grama" grass, *Paspalum* sp., at Lake Guánica, P. R., June 30, 1936. The type female and paratype female from San Germán, P. R., are deposited in the U. S. National Museum.

Anagyrus graminicolens, new species

A species easily recognized by its long, prominently protruded, dark ovipositor, and very conspicuous black and white antennae.

Female.—Length, including ovipositor, 2.15 mm., expanse 2.75 mm., greatest width of forewing 0.372 mm. General color a soiled brownish-orange, the head black, the pronotum and mesoscutum black, the scutellum distinctly orange; antennae black except the conspicuously white distal third of the pedicel, second and sixth funicle joints, and entire club; the scape deep black with a transverse conspicuous clear white area near its tip; legs soiled yellowish-orange, ovipositor sheaths black.

Rather elongate in general appearance owing to the very long, prominently protruded ovipositor, the well-tapered abdomen, and the long, slender antennae. Eyes with rather sparse, short, pale setae. Antennae very long and slender, 1.06 mm. in length, covered with numerous short hairs; the scape conspicuously dilated below or foliaceous, three times as long as greatest width, with three very strong setae present at edge of the transparent clear area; first funicle distinctly the longest funicle joint, nearly twice as long as the pedicel; funicle 2 very slightly longer than funicles 3, 4, and 5, which are subequal in length and width; funicle 6 slightly shorter and wider. Darker portions of the body appearing under high magnification in balsam mounts to be minutely but distinctly reticulate. Forewings 1.15 mm. in length and 0.372 mm. in width, rather uniformly ciliated except for the oblique hairless streak. Both thorax and abdomen rather elongate, the latter about a third longer than the thorax, tapered to the prominently protruded ovipositor, which extends for a length of about 0.33 mm. beyond the tip of the abdomen.

Male.—Unknown.

Type.—Cat. No. 51743, U. S. National Museum.

Described from the type female taken by writer sweeping grass and low weeds in beach association, Mani Beach, P. R., August 11, 1935, and a series of 47 paratype females taken sweeping "grama" grass, *Paspalum* sp., in open pasture at Lake Guánica, June 30, 1936. Type female and two paratype females, mounted in balsam on individual slides, together with six paratype females preserved dry and sixteen paratype females in alcohol, are deposited in the U. S. National Museum. The species will undoubtedly prove to be a primary parasite of a grass-feeding mealybug, when its biology is known.

Homalopoda cristata Howard

Howard, Journ. Linn. Soc. London, Zool., 25, p. 91, 1894.

This species was originally described from a single female from St. Vincent. A female, reared by the writer from *Ceroplastes giganteus* Dozier on *Ficus rubricosta* at Source *Cazeau*, Haiti, Dec. 11, 1930, was compared with the type in the National Museum and

proved to be identical. A single female was taken by the writer sweeping at sides of drainage ditch in a sugarcane field at Guayama, P. R., Jan. 17, 1936, and two females were taken on a leaf of a roadside shrub at Mayagüez, P. R., Jan. 23, 1936.

Pseudhomalopoda prima Girault

Girault, Journ. N. Y. Ent. Soc., 23, pp. 171–172, Sept. 1915.

A female was reared by the writer from *Chrysomphalus aonidum* on palm at Damien, Haiti, April 25, 1930, and compared with the type in the National Museum. A second female specimen was reared from *Terminalia catappa* foliage infested with *Aspidiotus destructor* and *Saisettia oleae* at Port-au-Prince, Haiti, Dec. 13, 1929. Dr. Giuseppe Russo reared a female from *Chrysomphalus aonidum* at Moca, República Dominicana, Dec. 12, 1926. The writer reared a female from lemon foliage infested with *Chrysomphalus aonidum* and *Lepidosaphes beckii* at Mayagüez, P. R., Sept. 28, 1935.

Anicetus annulatus Timberlake

Timberlake, Proc. Haw. Ent. Soc., 4, no. 1, p. 277, 1919.

A single female of this species was reared by the writer from "Petit calecon", *Bauhinia divaricata,* material at Source Cazeau, Haiti, Dec. 8, 1930. A female is at hand, reared by Dr. Giuseppe Russo from *Lecanium* scale on rose at Santo Domingo, República Dominicana, April 30, 1927. It has been reared in California and Japan from *Coccus hesperidum* and *Coccus pseudomagnoliarum.* It was definitely shown to be a primary parasite by Harold Compere in 1924.

Metaphycus monticolens, new species

Recognized immediately by its very distinctive orange and fuscous coloration, with distinct metallic reflections.

Female.—Length 0.932–1.00 mm., expanse 1.85 mm., greatest width of forewing .0257–.0272 mm.

Head and pronotum black with slight bluish metallic reflections, practically the entire prescutum dark but a shade lighter and with distinct greenish metallic reflections; remainder of thorax a beautiful contrasting orange, and abdomen fuscous with aeneous reflections. Antennae a soiled testaceous orange, basal two-thirds of pedicel infuscated. Legs pale yellowish; middle femora at their distal fourth and proximal fourth of middle tibiae annulated with fuscous; hind femora slightly infuscated at tip. Forewings hyaline, with a distinctive irregular cross band of light brown occupyng the area of the marginal and stigmal veins, and beneath same following the oblique hairless area to the posterior margin,

where the cloud enlarges and extends distally along the margin for a short distance.

Eyes almost hairless, with a few transparent setae barely visible under highest magnification. Antennae rather slender, the scape flattened on the underside but not expanded, long and slender, five times as long as wide; pedicel somewhat pyriform, distinctly narrowed at base, longer than the first three funicle joints combined; first and second funicle joints subequal in length and width, slightly longer than the third; funicles 4, 5, and 6 increasing gradually in width and length; club as long as the entire funicle combined, twice as long as wide, obliquely truncate. Pronotum opaque, mesoscutum short, covered with numerous setae which break off easily in mounting, and six more prominent ones along near the posterior margin; axillae with five setae each; scutellum under high magnification appearing elongately reticulated, provided with twenty strong setae. Forewings nearly three times as long as wide, measuring .076 mm. in length by .027 mm. in width; postmarginal vein rudimentary; marginal vein much shorter than the submarginal, the latter with four strong marginal bristles; uniformly ciliate distad of the oblique hairless streak. Abdomen shorter than the thorax, somewhat subtriangular in outline, the ovipositor slightly, if at all, protruded.

Male.—Unknown.

Type.—Cat. No. 51761, U. S. National Museum.

Described from the type female, collected by the writer sweeping shrubbery at 3.000 ft., Maricao, P. R., August 18, 1935 and a paratype female taken by the writer on a "guama", *Inga laurina,* tree in a coffee grove in the mountains above Mayagüez, P. R., August 21, 1935.

Hunterellus hookeri Howard

Howard, Canadian Entomologist, 40, pp–239–241, 1908.

Collections of the brown dog tick, *Rhipicephalus sanguineus* Latr., made at irregular intervals at Mayagüez, P. R., from Sept. 24 to November 4, 1935, on a police dog showed a very heavy percentage of parasitization. Parasites issued in numbers on Oct. 23d., and from 10 isolated swollen ticks a total of 77 parasites issued from Nov. 1–4. In every case the parasites issued from second-stage females, each body showing an exit hole towards the posterior end from which one or more parasites issued. Apparently the adult females and males are not attacked. The host tick became much less abundant during November and this could be accounted for by the activity of *Hunterellus hookeri.* More parasites were reared on November 30 from the few ticks collected Two ticks collected on December 2d yielded 16 parasites and a tick collected on December 13th yielded 4 parasites on January 3d. The latter part of December saw a decided increase in the tick again.

Family EULOPHIDAE

Subfamily Aphelininae

Hispaniella howardi, new species

This species might easily be confused with *Aspidiotiphagus citrinus* Howard but is distinguished at once by having only four tarsal joints and broader forewings. A rather short and robust species, very distinct from the European *Hispaniella lauri* (Mercet).

Female.—Length, including ovipositor 0.35–0.40 mm., expanse 0.817 mm., greatest width of forewing 0.086 mm. General color yellowish, the sides of the thorax, base of abdomen, and sides along the middle marked with fuscous; anterior margin of prescutum and pronotum infuscated along the middle; antennae uniformly dusky; legs pale.

Head as wide as thorax, the eyes large and prominent. Antennae 8–jointed, somewhat flattened, the scape long and slender; pedicel distinctly wider than the scape and about one-third as long; first funicle joint decidedly the smallest joint, about half as wide as the pedicel; funicles 1, 2, and 3 increasing in width and length successively; club 3–jointed, the second joint the broadest, slightly longer than the first, and subequal in length to the rather pointed terminal joint; microscopic longitudinal sensoria present on last funicle joint and club. Eyes hairless. Ocelli placed in an equilateral triangle, red. Under high magnification the prescutum and scutellum appear to be faintly and coarsely reticulated. Forewings rather broad, the outer anterior margin well rounded; marginal vein furnished with five distinct marginal setae; the submarginal vein always with a single small inconspicuous seta; disk with numerous, fairly uniformly arranged, short setae, a bare area about the stigma; marginal fringe of cilia very long, those on posterior margin distinctly longer than those on the anterior margin, the longest equaling the width of the wings. Forewings hyaline except for a clouded area which extends across the entire width of the wing behind the marginal vein; marginal vein dusky. Abdomen much longer than the thorax but distinctly narrower; the ovipositor slightly exserted. All tarsi 4–jointed.

Male.—Unknown.

Type.—Cat. No. 51685, U. S. National Museum.

Described from a series of twenty six females mounted in balsam, and which were reared by the writer from *Parlatoria pergandii camelliae* Comstock (det. Harold Morrison), on Croton foliage at Port-au-Prince, Haiti, April 13–May 6, 1931. The type female on a slide with a single paratype female, and eight paratype females on two slides, are deposited in the U. S. National Museum.

Named in honor of Dr. L. O. Howard, who did so much excellent pioneer work on scale parasites.

Prospaltella pulchella, new species

An unusually beautiful species. Nearest to *P. murtfeldtii* (Howard) but differing at once in the extent of clouding of the fore-wings and by having the first funicle joint silvery white instead of brown. Also closely allied to *P. fasciativentris* Girault but the anterior femora are not annulated with dusky nor is the abdomen shining piceous as in that species which also has funicle 1 distinctly brown and funicle 2 more dusky than 3.

Female.—Length, including ovipositor, 0.731 mm., expanse 1.305 mm., greatest width of forewing 0.20 mm. General ground color light yellowish; the thorax somewhat varicolored, in general brownish, the sides lighter, the pronotum, metanotum and propodeum distinctly fuscous. Antennae with the scape and pedicel slightly dusky, all three funicle joints silvery-white; the first two club joints dark brown, the terminal joint white, slightly dusky towards the base. Vertex dusky yellowish, the ocelli red. Forewings hyaline, with a broad infumation or fuscous cloud extending across the wing beneath the distal half of the marginal vein and reaching beyond the stigmal vein. Abdomen fuscous, the apex, the sides irregularly so, and a broad transverse band across the basal fourth, silvery-white. Legs pale, the middle and hind tibiae each with a single fuscous annulation, the middle femora with an indication of a fuscous clouding on lower margin; first and second tarsal joints of anterior legs brown, the middle and hind tarsi with only first joint brown.

Head transverse, distinctly wider than the thorax, the prominent eyes naked. Antennae fusiform, conical at apex, with distinct longitudinal sensoria; scape long and slender, five times as long as wide, narrower than pedicel; pedicel distinctly wider than first funicle joint and twice as long; the three funicle joints successively shorter and slightly increasing in width, funicle 3 nearly twice as long as funicle 1; club 3-jointed, tapered to conical apex, the first joint distinctly the widest, and slightly longer than the second, the terminal joint the longest, pointed. Under high magnification the prescutum, axillea, and scutellum appear coarsely polygonally reticulate, the areas along median line of scutellum longitudinally elongated; the prescutum with a pair of extra strong lateral setae, and nine smaller ones on each side; the scapulae with three setae each, the axillae each with a single one, and the scutellum with a pair of strong setae on each side. Forewings broad, about two and a half times as long as wide (measuring 0.50 mm. in length by 0.20 mm. in width), marginal vein almost equal in length to the submarginal; stigmal vein very short, its anterior border nearly parallel with the costa, shaped somewhat like the head of a bird; disk of wing rather densely ciliated, the cilia less abundant on basal portion beneath the submarginal vein and a large conspicuous area lying beneath basal half of marginal vein appearing hairless owing to the transparency of the pale cilia at that point. Abdomen somewhat ovate in outline, the ovipositor slightly protruded. Tarsi 5-jointed.

Male.—Unknown.

Type.—Cat. No. 51754, U. S. National Museum.

Described from a single female, reared June 17, 1931, by the writer at Port-au-Prince, Haiti, from a shipment of apple twigs

infested with the wooly apple aphid, collected at Camden, Del., and forwarded by L. L. Williams in connection with the attempted introduction of *Aphelinus mali* (Haldeman) into Haiti. The species is undoubtedly a parasite of some apple-infesting coccid.

This species is a typical *Prospaltella* and is certainly congeneric with the genotype, *Prospaltella murtfeldtii* (Howard), and with *P. fasciativentris* Girault, *P. fasciapennis* Girault, and *P. forbesi* Dozier, all of which have the conically pointed club and the stigma bearing a resemblance in outline to that of a bird's head.

Prospaltella elongata, new species

Easily distinguished by coloration and its comparatively narrow, elongated form, an adaptation apparently to the extremely elongated body of its host scale.

Female.—Length, including ovipositor, 0.50 mm., expanse 1.13 mm., greatest width of forewing 0.158 mm. General coloration yellowish-orange, nearly the apical two-thirds of the abdomen, the ovipositor, the upper portion of the head, the pronotum, and the anterior margin of the prescutum, fuscous; antennae uniformly yellowish-orange; legs pallid.

Head slightly wider than the thorax, the vertex transversely rugulose. Antennae long, somewhat flattened, with longitudinal sensoria, the club distinct but only slightly wider than the funicle; scape long and narrow, about five times as long as wide; pedicel half as long as the scape but distinctly wider than either the scape or funicle; first funicle joint very short, only half as long as the second funicle; funicle joints 2 and 3 subequal in width and length; club 3-jointed, the first and second joints subequal in width and length, the terminal joint nearly a fourth longer and narrowed to apex. Under high magnification the pronotum, prescutum, scutellum, and axillae appear faintly and coarsely reticulated. Prescutum with eight strong setae, the axilla with a single strong seta, and the scutellum with a pair. Forewings rather broad, 0.459 mm. in length and 0.158 mm. in width, well rounded at apex; submarginal vein with a pair of strong setae; marginal vein with eight strong setae along its anterior margin; a broad infumation or clouding extending from beneath the marginal vein and stigma across the width of the forewings. Abdomen distinctly longer and narrower than the thorax, narrowing apically to a well-rounded apex where the ovipositor is prominently protruded or exserted.

Male.—Unknown.

Type.—Cat. No. 51681, U. S. National Museum.

Described from a series of 69 females reared by the writer from the long scale, *Lepidosaphes gloveri* (Packard), on a *Euonymus* shrub in a yard at New Orleans, La., January 6, 1926. The type female and 5 paratype females on one slide, 10 paratype females on a second slide, and 9 paratype females on a third, slide, are deposited in the U. S. National Museum.

This species appears to be a very important parasite and is probably responsible for the fact that the long scale is a minor pest of citrus in the Gulf Coast region, while the purple scale, *Lepidosaphes beckii* (Newman), unchecked by natural enemies, is the most serious enemy of citrus. The writer has observed numerous emergence holes of this parasite in *Lepidosaphes gloveri* at Mobile, Ala.

Encarsia nigricephala, new species

Belongs to the group having the middle tarsi 4-jointed. Distinguished immediately from all other described members of the genus by having the head, pronotum, and anterior two-thirds of the prescutum black. Closely related to *Encarsia cubensis* Gahan but differing in color.

Female.—Length, including ovipositor, 0.46 mm., expanse 1 mm., greatest width of forewing 0.115 mm. General color pale yellowish, contrasting greatly with the black head, pronotum, and anterior discal two-thirds of prescutum; the fuscous portions appearing distinctly reticulate under high power. Head about as wide as thorax, the eyes faintly hairy under high magnification. Prescutum with a single strong seta placed near the margin on each side. Antennae long and slender, testaceous yellow; pedicel almost twice as long as the first funicle and distinctly stouter; first funicle decidedly the shortest antennal joint; funicles 2 and 3 successively slightly longer and subequal in width; funicle 4 slightly longer and wider; terminal joint a third longer than first club joint, widened noticeably at base and then slightly tapered. Forewings rather small (0.40 mm. in length by 0.115 mm. in width), the longest cilia of marginal fringe longer than half the width of the wing; submarginal vein with two setae; wing surface rather sparsely ciliated, the cilia absent from a large bare area embracing the stigmal vein and a border around the outer portion of the wing. Abdomen distinctly shorter than thorax, ovipositor strongly exserted. Legs entirely pallid; all tarsi except those of the middle legs 5-jointed.

Male.—Unknown.

Type.—Cat. No. 51607, U. S. National Museum.

Described from three females reared by the writer from an undescribed whitefly, *Bemisia* sp., abundant on a weed *Euphorbia hypericifolia,* in a backyard at Mayagüez, P. R., February 12, 1936. These are mounted in damar balsam on individual slides.

Subfamily Tetrastichinae

Tetrastichus tatei, new species

This species could be placed in the genus *Geniocerus* Ratzeburg, following Kourdumoff, as it has more than one bristle on the submarginal vein, but this grouping seems unnatural. Members of the genus *Tetrastichus* Haliday are quite varied in their habits. The

new species is the second described as a definite thrips parasite. *Tetrastichus gentilii* Del Guercio was described as a parasite of *Phloeothrips oleae* in 1911.

Female.—Length about 1–1.16 mm. Dark brown in color, the eyes conspicuously red, with the antennae and legs yellowish-testaceous, and a light or clear median area occuping over a third of the abdomen at its base. This clear area is very characteristic of the species. Antennae 9–jointed including a single minute ring-joint that is visible under high magnification; the three funicle joints subequal in length, the first slightly longer than the pedicel; club slightly wider than funicle, tapered, and only slightly longer than funicle joints 2 and 3 combined. Median furrow on mesoscutum and pair of furrows on scutellum distinct. Forewings hyaline, veins testaceous-yellow; submarginal vein with two very distinct bristles and a less distinct, more posteriorly placed one. Abdomen elongate, almost twice as long as thorax, distinctly petiolate, narrowest at base, the ovipositor nearly concealed.

Male.—Unknown.

Type.—Cat. No. 51608, U. S. National Museum.

Described from numerous females reared by the writer from swollen last-instar nymphs of *Gynaikothrips uzeli* (Zimm.), curling the foliage of Cuban laurel, *Ficus nitida,* on the Experiment Station grounds at Mayagüez, P. R., March 26–April 5, 1936. The Type female mounted in balsam on a slide and paratypes on slides, dry, and in alcohol are deposited in the United States National Museum. Named in honor of H. D. Tate, who called the writer's attention to the damage being occasioned by this thrips.

Family MYMARIDAE

Mymar antillanum, new species

In number of primary marginal cilia this species is closest to *Mymar cincinnati* Girault but differs at once in having the discal ciliation of forewings cephalad of the mid-longitudinal line of cilia.

Female.—Length, including ovipositor, 0.645 mm., expanse 1.749 mm., greatest width of forewing, exclusive of marginal cilia, 0.068 mm. Head, thorax, and abdomen dark brown or fuscous, basal third of abdomen distinctly lighter; pedicel pale; flagellum light brown; legs pale yellowish, slightly embrowned, terminal joint of tarsi distinctly fuscous.

Antennae 9–jointed; scape very long, somewhat curved, swollen at base and apex, four times as long as the short, rather stout pedicel; first funicle only slightly longer and distinctly narrower than pedicel; second funicle by far the longest joint, five times as long as the first, perceptibly enlarged distally; funicles 3, 4, and 5 subequal in length, 6 slightly longer and thicker. The forewing on a very long stalk, the distal portion greatly widened into a distinct blade oar-like; slightly over half of distal part of blade broadly infuscated, line of demarcation very irregular and somewhat oblique; primary marginal cilia 42

in number; discal cilia of the blade mostly cephalad of a mid-longitudinal line which extends from near apex to base of blade. Hind wing reduced to a long, narrow, bristle-like appendage, of which the portion basad of the hooklets is bare, beyond the hooklets for some distance sparsely armed with short setae, the apical one-fourth bare and very slender; the portion beyond the hooklets twice as long as that from base to the hooklets but easily broken off. Abdomen distinctly petiolate, the petiole narrow and about half as long as the abdomen; ovipositor slightly exserted beyond the tip. Legs long and slender, the tarsi 4-jointed.

Type.—Cat. No. 51684, U. S. National Museum.

Described from the type female, collected by the writer sweeping grass and sedges at roadside pond edge near Boquerón, P. R., Sept. 5, 1935; a paratype female taken sweeping grassy path in dense coffee glade at 1,000 ft. in mountains at Las Vegas, P. R., Jan. 2, 1936; a paratype female sweeping low vegetation in an irrigation ditch at the Experiment Station, Mayagüez, P. R., February 28, 1936; and a paratype female taken sweeping grass at swampy edge of roadside, Lake Guánica, P. R., July 13, 1936.

Gonatocerus portoricensis, new species

Closest in general appearance to *Gonatocerus fasciatus* Girault on account of the cross-band on forewing but distinguished at once by its yellowish-orange abdomen, transversely banded with brown.

Female.—Length, including ovipositor 0.774 mm., expanse 1.72 mm., greatest width of forewing 0.222 mm. Head and entire thorax, black; antennae with flagellum dark grayish brown, the scape and pedicel lighter brown; abdomen yellowish-orange in life, fading to a soiled yellowish in balsam mounts, with the tip and four distinct cross-bands or vittae along the anterior margins of segments brown; legs yellowish-brown, the tibiae more deeply infuscated.

Head slightly wider than thorax. Antennae long and rather slender; scape distinctly flattened, three times as long as its greatest width and about twice as long as the pedicel; pedicel narrower than the scape but distinctly wider than the funicle joints, all subequal in length, widening slightly, the first barely perceptibly the shortest; club solid, twice as wide as the last funicle joint and about three times as long. Forewings long, slightly over three times as long as the greatest width; hyaline, the venation and a very distinctive cross fascia near apex of venation brown; rather uniformly ciliated, the ciliated area delimited by a line of cilia which runs from the base of the marginal vein obliquely outward to the posterior margin. Abdomen somewhat ovate, slightly longer than thorax, ovipositor slightly but distinctly exserted; transverse rows of very distinct strong setae arranged along each of the four brown cross vittae and tip in a very characteristic manner.

Male.—Length 0.86 mm. Differs from the female by the long, brown, 13-jointed antennae, distinctly flattened; all joints except the scape and pedicel with longitudinal sensoria; the first funicle slightly the shortest, the others subequal in length and narrowing only slightly, the tip somewhat pointed.

Described from single female specimens collected by the writer in Porto Rico as follows:—Swept from cotton at Isabela, August 1935, sweeping low grass, etc., at roadside, Boquerón, Sept. 5, 1935; sweeping shrubby hillside pasture at 1,000 ft., Mayagüez, Oct. 3, 1935; sweeping hillside weeds in mountains at 1,300 ft., Villalba, Oct. 25, 1935; sweeping bamboo at river edge, Hormigueros, Oct. 31, 1935; swept from pure stand of coffee seedlings in bed near Mayagüez, Nov. 17, 1935; sweeping hillside shrubbery at 1,800 ft., Maricao, Dec. 19, 1935; two females, sweeping grass and weeds at sides of drainage ditch in canal, at Guayama, Jan. 17, 1936; male taken in pasture at Guanajibo, Sept. 11, 1935, and another from roadside weeds at Ensenada, Dec. 5, 1935; a male and a female taken sweeping weeds along Añasco river near Las Marías, July 28, 1936.

Type.—Cat. No. 51678, U. S. National Museum.

Holotype female from cotton at Isabela, P. R., Aug. 19, 1935, allotype male from roadside weeds at Ensenada, Dec. 5, 1935, and the paratype female from Hormigueros, P. R., Oct. 31, 1935 are deposited in the U. S. National Museum collection.

Gonatocerus antillensis, new species

Closest to *Gonatocerus koebelei* Perkins but differentiated immediately by the darker legs and antennal difference.

Female.—Length, including ovipositor, 0.832 mm.; expanse 1.635 mm., greatest width of forewing 0.158 mm. Black, the abdomen narrowly banded with yellow at base, the scape and pedicel a shade lighter than the flagellum in color; legs fuscous.

Antennae rather long, the scape about twice as long as the pedicel, three times as long as wide; funicle joints subequal in length except 5 and 7 which are slightly longer; club solid, equal in length to the last three funicle joints combined. Thorax short and broad, longer than wide. Forewings rather slender, almost five times as long as wide; hyaline, with a very distinct large smoky spot or infumation occupying most of the apical fifth but not quite touching the margins; rather uniformly covered with cilia except a small clear area just distad of stigma, the ciliation terminating towards base at an oblique line running to origin of marginal vein. Abdomen elongate, nearly twice as long as wide, petiolate but petiole very short and inconspicuous; ovipositor distinctly exserted for about a sixth of the abdominal length; ovipositor valves gray.

Male.—Unknown.

Type.—Cat. No. 51679, U. S. National Museum.

Described from the type female, collected by the writer sweeping roadside vegetation at 1,000 ft. near Mayagüez, P. R., Oct. 14, 1935; a paratype female taken sweeping steep roadside slopes, covered with

fern, shrubs, etc., at Miradero, P. R., Sept. 13, 1935; and three paratype females taken sweeping "cohitre", *Commelina longicaulis*, etc., in mountains at 650 ft., Las Vegas, P. R., Dec. 26, 1935.

Erythmelus longicornis, new species

Recognized easily by the unusually long antennae and the pale, dirty yellowish legs.

Female.—Length, exclusive of ovipositor, 0.674 mm., expanse 1.047 mm., greatest width forewing 0.0789 mm. General color fuscous-black, the basal half of the abdomen pale yellowish; antennae grayish-brown, the scape, pedicel, and first funicle barely perceptibly lighter; legs pale, dirty yellowish, front trochanters distinctly pallid, the hind femora darker.

Antennae 9–jointed, unusually long and slender for the genus, the sixth funicle joint distinctly the longest funicle joint, nearly twice as long as the others and distinctly thicker, the scape elongate, subequal to the club in length; pedicel short and stout; funicle 1 distinctly the shortest antennal joint, about half as long as funicle 3, 4, and 5, which are subequal in length; funicle 2 barely but perceptibly shorter than 3, 4, and 5; club solid, only moderately stout, being four times as long as wide. Thorax elongate, slightly shorter than abdomen. Forewings nearly six times as long as greatest width, infumated at base; marginal vein with two prominent setae near anterior margin and two small setae present, placed just distad of the larger prominent ones; distal third of forewing with short discal cilia; marginal cilia along outer posterior margin, longest and a third longer than greatest width of blade. Abdomen somewhat elongate, the pale ovipositor exserted but the hypopygium covers the ovipositor to the apex of the abdomen, as is characteristic for the genus.

Type.—Cat. No. 51755, U. S. National Museum.

Described from a single female taken by the writer sweeping low weeds, etc., in the sandy beach association at Mani Beach, near Mayagüez, P. R., August 11, 1935.

Erythmelus miridiphagus, new species

Closely allied to *Erythmelus longicornis* Dozier but distinguished immediately by the shorter antennae, fuscous legs, and different arrangement of discal setae of forewing.

Female.—Length, exclusive of ovipositor 0.574 mm., expanse 0.932 mm., greatest width of forewing 0.0789 mm. General color black, basal half of abdomen pale yellowish; antenna fuscous, the pedicel a trace lighter; legs for the most part distinctly fuscous, the tibiae, tarsi, and distal tips of femora of front legs pallid; basal third of hind tibiae pallid.

Antennae slightly shorter and stouter than those of *E. longicornis* Dozier, the sixth funicle joint being about twice as long as any other funicle joint; scape four times as long as its greatest width slightly shorter than the club; pedicel short and stout, less than half as long as the scape; first funicle very short, half as long as the second; funicles 2, 3, 4, and 5 subequal in length

and increasing barely perceptibly in width slightly narrower than the 6th; club moderately enlarged, almost five times as long as greatest width. Thorax and abdomen elongate, the latter slightly the longest, with the ovipositor distinctly exserted. Forewings five times as long as their greatest width, slightly infumated at base; marginal vein gray, with two large prominent marginal setae and two smaller ones; distal third of forewing rather sparsely covered with short cilia, with a few inconspicuous ones arranged in an irregular, median line extending basally.

Type.—Cat. No. 51682, U. S. National Museum.

Described from a series of 29 females collected by the writer from a pure stand of *Amaranthus* at edge of cane field at Hormigueros, P. R., Oct. 1, 1935. Enormous numbers of *Polymerus cuneatus* Distant were breeding on this weed and without doubt *E. miridiphagus* is a true egg parasite of this mirid. Heretofore nothing has been recorded in literature as to the hosts of species of *Erythmelus*. Although the species was very abundant at the time, no males could be located. The type female and 10 paratype females, mounted in balsam, are deposited in the U. S. National Museum.

Erythmelus nanus, new species

Most closely allied to *Erythmelus gracilipes* (Girault) of the United States. A small, short, compact species.

Female.—Length, exclusive of ovipositor, 0.573 mm., expanse 0.960 mm., greatest width of forewing 0.086 mm. General coloration, including the antennae, black, the basal third of the abdomen whitish; legs black except the pale yellowish front tibiae and tarsi and the hind trochanters.

Antennae short and stout in comparison with those of other species, the sixth funicle joint only twice as long as wide and subequal to the fourth funicle; scape long, nearly three times as long as the short, stout pedicel; first funicle distinctly the shortest and smallest joint; club stout, nearly three times as long as wide. Thorax and abdomen nearly equal in length and having a more compact appearance than in *E. longicornis* Dozier and *E. miridiphagus* Dozier, and the forewings are broader. Fore and hind wings lightly infumated, slightly paler beneath the marginal vein. Forewings broad, nearly five times as long as wide, the distal fourth with sparse short cilia, arranged in 4–5 lines against the cephalad margin and a line near the posterior margin; marginal cilia very distinct, the longest along the outer posterior margin being just slightly longer than the greatest wing width. Abdomen rather broad, rounded to tip, the ovipositor only slightly exserted.

Type.—Cat. No. 51683, U. S. National Museum.

Described from a type female, collected by the writer sweeping low vegetation along banks of a rocky river at Las Vegas, P. R., Jan. 6, 1936, at 650 ft. elevation in the mountains; and two paratype females taken sweeping low grass and weeds in a pasture at Guanajibo, P. R., Sept. 11, 1935.

Family TRICHOGRAMMIDAE

Oligosita magnifica, new species

Closest to *Oligosita novisanguinea* Girault of Australia but slightly smaller and with the broad basal band of abdomen distinctly yellow instead of white. This species is also closely allied in structure and coloration to the North American *O. sanginea* Girault but distinguished at once by the characteristic yellow band across the base of the abdomen.

Female.—Length, 0.487–0.674 mm., expanse 0.922 mm., greatest width of forewing 0.086 mm. General color a beautiful bright sanguineous or blood red, the base of the abdomen with a broad transverse band of bright yellow covering nearly half its length (this fades greatly in balsam-mounts, legs dusky; antennae concolorous with the legs, the distal two joints slightly darker.

A rather small species. Head about as wide as thorax. Antennae 7–jointed, including a single minute ring-joint; club slender, 3–jointed, at base wider than the funicle joints, narrowed to a point and with a very distinct terminal spine; proximal joint of club distinctly shorter than second or intermediate. Forewings over four times as long as wide, with a very distinct sooty black substigmal spot or suffusion; discal cilia almost entirely absent; marginal cilia longest at the rounded apex, slightly longer than the greatest width of the forewing. Abdomen about a fourth longer than the thorax, robust, narrowed to apex, the ovipositor barely exserted.

Male.—Unknown.

Type.—Cat. No. 51680, U. S. National Museum.

Described from the type female collected by the writer sweeping low grass at edge of Cartagena lagoon. P. R., Nov. 11, 1935; a paratype female taken sweeping sedges and grass at low wet roadside near Boquerón, P. R., Sept. 5, 1935; and a paratype female swept from grass near Bayamón, P. R., June 17, 1936.

THE MOSQUITOES OF PUERTO RICO

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INTRODUCTION

The purpose of this paper is to report the results of mosquito investigations in Puerto Rico during the period July 5, 1935, to June 1, 1936. These investigations were carried on with special funds available to the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture for studies on insects of Puerto Rico. They were under the technical direction of the Division of Insects Affecting Man and Animals, and conducted in cooperation with the Federal Experiment Station at Mayagüez, where headquarters for the investigations were located. Mayagüez is situated in a region of heavy rainfall, and its proximity to the mountainous regions at Maricao and the extremely dry arid region on the southern coast made it a convenient center from which to study mosquitoes under various ecological conditions.

Puerto Rico is a mountainous tropical island. Topographically it consists of a large central mountainous region surrounded by a relatively narrow coastal plain. On the basis of variation of rainfall, the island may be divided in a general way into three regions: (1) the wet coastal plains of the north, east, and west; (2) the dry southern coastal plain, and (3) the central mountainous area, which is subject to heavy rainfall. Practically all of these regions receive their maximum precipitation late in the summer and early in the autumn (August to October) whereas the winter period (December to March) is noticably drier. The average annual temperature along the coastal region is between 75° and 80° F. Because of the influence of the surrounding ocean, seasonal and daily variation in temperature is not pronounced.

PREVIOUS WORK ON THE MOSQUITOES OF PUERTO RICO

In 1922 Root (**22**)[1] reported a list of mosquitoes that he had taken in Puerto Rico together with a summary of all previously reported species. Since that time many new species have been added (Johnson (**13**), Dyar (**2**), Wolcott (**26**)) and the taxonomic status of

[1] The numbers in parenthesis refer to publications given in the bibliography at the end of this paper.

others has been revised (Dyar (**2**)). The following is a list of the species which have hitherto been reported from the island with references to the papers in which the original records appeared; certain doubtful records have been omitted.

Anopheles albimanus Wiedemann (**21**), (**12**), (**25**).
Anopheles grabhamii Theobald (**12**), (**25**).
Anopheles vestitipennis Dyar & Knab (**13**), (**2**).
Megarhinus portoricensis Roeder (**21**).
Aedes sollicitans (Walker) (**26**).
Aedes taeniorhynchus Wiedemann as *A. portoricensis* (**12**).
Aedes mediovittatus (Coquillett) (**24**).
Aedes aegypti (L.) (**12**), (**24**), (**25**).
Psorophora jamaicensis (Theobald) (**12**).
Culex quinquefasciatus Say (**12**), (**24**), (**25**).
Culex secutor Theobald as *C. toweri* (**12**), (**2**).
Culex americanus (Neveu-Lemaire) as *C. bisulcatus* (**12**).
Culex antillum-magnorum Dyar (**2**).
Culex nigripalpus Theobald (**24**) as *C. similis.*
Culex atratus (Theobald) (**22**).
Culex habilitator Dyar & Knab (**26**).
Culex inhibitator Dyar & Knab as *C. borenquini* (**22**), (**2**).
Culex bahamensis Dyar & Knab (**26**).
Deinocerites cancer (Theobald) (**22**).
Uranotaenia sapphirina Ousten-Sacken as *U. socialis* (**22**), (**2**).
Uranotaenia lowii Theobald (**22**).
Mansonia titillans Walker (**26**).
Wyeomyia mitchellii ? Theobald (**26**).
Dixa sp. probably *clavulus* Williston (**26**).
Corethrella spp. probably *appendiculata Grabham* (**26**).

The literature considered in the foregoing paragraphs has been concerned with the taxonomy of mosquitoes. There are many other papers which deal with the habits of mosquitoes and their relationships to such diseases as malaria, filaria, and dengue in Puerto Rico, and these are included along with others of a general nature in the bibliography (**1, 3, 4, 5, 6, 7, 8, 9, 10, 11, 14, 15, 16, 17, 18, 19, 20, 21, 23**).

Economic Importance of the Mosquitoes of Puerto Rico

The geographic position of Puerto Rico is such that climatic factors are favorable for the development of mosquitoes throughout the entire year. The general mosquito problem, therefore, is of

a greater magnitude than that of countries in temperate zones where mosquitoes are active only during a portion of the year. Not only are mosquitoes annoying to man and animals during the entire year, but many of the species transmit the causative organisms of disease.

Mosquitoes are of distinct importance because of the discomfort caused to man and animals by their bites. This is particularly true in the coastal region where the greatest concentration of population is found. The use of bed nets for protection during sleeping hours is a rather general practice, yet there are many people who, because of economic reasons, are unable to avail themselves of this means of protection. The practice of screening houses is not common and consequently practically all of the people are subjected to some degree of annoyance during their waking hours even though many of them are protected during their sleeping hours. Annoyance, then, is a general problem involving a large majority of the people. More important, from a health standpoint, however, are the consequences resulting from the transmission of causative organisms of certain diseases of man by mosquitoes.

One of the most serious health problems which confronts Puerto Rico is malaria. The number of deaths caused by this disease has been between 1,000 and 2,000 annually. Previous to 1924 there were few studies dealing with the incidence of this disease in Puerto Rico. In that year, however, the International Health Board of the Rockefeller Foundation initiated a study to obtain more complete information on all the phases of the malarial problem. The progress of this work has been reported in a series of publications by Earle (**3–10**). Among other things, these studies have indicated that malaria is a serious health problem mainly in the coastal region where the cultivation of sugarcane is the important industry, and that control of the anopheline mosquitoes is practicable in many of the regions where the incidence of malaria is high.

The distribution of filariasis has been studied by Hoffman et al. (**11**). Their studies indicate that this disease is, in the main, limited to the coastal region with Aguadilla on the western coast and parts of San Juan on the northern coast as the most important endemic foci. This disease is not as important as malaria.

Prior to the American occupation of Puerto Rico, yellow fever was a common and, at times, an epidemic disease. Since the American occupation, several cases of this disease have been removed from incoming vessels to the quarantine station by public health officials. The mosquito *Aedes aegypti,* which transmits this disease, is very common in the coastal region of Puerto Rico.

Dengue, although seldom fatal, is a specific fever of warm countries. Frequent cases are reported in Puerto Rico. The nature of the causative organism is not clearly understood, but it is agreed that *Aedes aegypti* is involved in its transmission.

METHODS OF COLLECTION AND IDENTIFICATION

Field collections of larvae were made in all situations in which stagnant or slowly moving waters were present. Most of these collections were made in the western portion of the island but frequent survey trips were made into the eastern portion. The usual situations in which larvae were collected were street gutters and culverts, cisterns and rain barrels, drainage, roadside, and irrigation ditches, swampy areas, and along the margins of ponds, lakes, and rivers. In addition, water was taken from tree holes, crab holes, and the leaf bases of certain plants and examined. The temperature, hydrogen ion concentration, and chlorine content of waters containing larvae were determined by standard field methods. The forms were determined in the larval stage or reared and determined by adult characteristics.

Adults were taken by several methods. In order to determine the relative abundance and distribution of those mosquitoes attacking warm-blooded animals, horse traps were employed. The native horses are small so that a trap seven feet long, five feet high, and 4 feet wide is sufficient for this purpose. The small size of the trap facilities its transfer from one locality to another without difficulty. In addition, the cost of a horse suitable for this purpose is small, which further increases the desirability of the method. The procedure used was to put the horse in the trap late in the afternoon and to collect the trapped mosquitoes just before sunrise the following morning. Collection of adults by light traps was also found useful in determining abundance and distribution of various species, especially certain kinds not usually taken in horse traps. These traps were of the box type, the source of light being a 200-watt clear glass bulb. Other methods for collection of adults were collections in houses to determine the forms that enter dwellings, and net collections in the fields and woods and regions where the use of horse or light traps was impracticable.

The collections from the various sources were examined and the abundance and distribution of the species recorded. The specimens that could not be identified in the field were forwarded to the Division

of Insect Identification for determination. This opportunity is taken to acknowledge, with thanks, the invaluable assistance rendered by Dr. Alan Stone of that division.

HABITS, DISTRIBUTION,[2] AND SPECIES OF PUERTO RICAN MOSQUITOES

In general, the larval habitats of the various species of mosquitoes in Puerto Rico may be grouped under the following seven type locations:

1. Stagnant water around dwellings.
   (*a*) In cisterns and water barrels—*Aedes aegypti.*
   (*b*) In tin cans, temporary pools, and street gutters (fig. 1) —*Culex quinquefasciatus, Anopheles albimanus,* and occasionally *Culex nigripalpus.*
2. Open-country breeding places (swampy areas, roadside, drainage (fig. 2), and irrigation (fig. 3) ditches, and the edges of ponds (figs. 4 and 5), lakes, streams, and rivers)—*Psorophora pygmaea, P. jamaicensis, Aedes scapularis, A. taeniorhynchus, Culex pilosus, C. inhibitator, C. carcinophilus, C. atratus, C. nigripalpus, C. secutor, Uranotaenia sapphirina, U. lowii, Anopheles albimanus, A. grabhamii, Corethrella appendiculata.*
3. Crab holes—*Deinocerites cancer, Corethrella appendiculata.*
4. Tree holes—*Megarhinus portoricensis, Aedes mediovittatus, Corethrella appendiculata.*
5. Leaf bases of bromeliads and other plants (fig. 6)—*Wyeomyia mitchellii, Culex americanus, Megarhinus portoricensis, Corethrella appendiculata.*
6. Brackish water pools—*Psorophora pygmaea, Aedes sollicitans, A. taeniorhynchus, Culex inhibitator, C. bahamensis, C. nigripalpus, C. habilitator, C. atratus, Uranotaenia sp.,*[3], *Anopheles albimanus, A. grabhamii, A. crucians.*
7. Attached to roots and submerged stems of aquatic plants—*Mansonia indubitans, M. titillans.*

The following paragraphs give the species of mosquitoes collected by the writer in Puerto Rico with notes on their habits, abundance, and distribution.

1. *Wyeomyia (Wyeomyia) mitchellii* (Theobald).

This species is found breeding in the water contained in the leaf bases of epiphytic bromeliads in the higher altitudes of Puerto Rico.

[2] The distribution records indicated by (WAH) were made available by Dr. W. A. Hoffman of the School of Tropical Medicine. Records followed by HT indicate horse-trap collections and those followed by LT indicate light-trap collections. Unless otherwise indicated in the text, the remaining records refer to larval collections.

[3] A third species of this genus was taken in net collections in a thickly wooded area at Mayagüez in May, 1936. It represents a new species the description of which Dr. W. A. Hoffman has in manuscript.

The larvae are yellow in color and move about with a gliding motion over the debris in the leaf bases. The water in which they live is either slightly or distinctly acid, having a hydrogen ion concentration corresponding to a pH ranging between 4.0 and 6.5. The temperature of the water varies between 68° and 81° F., being lower on the higher points such as Bretton Peak in the Luquillo National Forest and higher at such points as Maricao. The adults are small bluish-green forms which have conspicuous white markings on the hind legs. Apparently they are not attracted to horses, since none were taken in a horse trap operated on Maricao Mountain during November 1935 at a time when larvae and pupae were present in the vicinity. At times they attack man but cannot be considered fierce biters.

Other species of mosquitoes associated with this form in bromeliads are *Culex americanus, Corethrella appendiculata,* and *Megarhinus portoricensis.*

Distribution Records: Maricao, August 15, 1935, No. 1;[4] Maricao Insular Forest, October 28, 1935, No. 1, January 20, 1935, No. 10, May 5, 1936; Luquillo National Forest, March 24, 1936, April 12, 1936, May 21, 1936.

2. *Psorophora* (*Grabhamia*) *pygmaea* Theobald.

The larvae of this species are large, have inflated air tubes, and prefer to live in temporary fresh-water ground pools containing little or no vegetation. However, they are able to develop in brackish water, for at Lake Guánica they were found in hoof-track pools containing 665 parts of chlorine per 100,000 parts of water.

The adults are large, well marked forms which are fierce biters during both night and day. In one case at Ponce on October 3, 1935, they were taken off white children playing in the bright sun shortly after noontime. No other observations of a similar nature were made during the investigation. They occasionally enter houses in search of blood; and they are also attracted to animals such as horses, since they usually were present in all horse-trap collections. A few were taken in light-trap collections.

The records available indicate that this species is fairly common on the southern coast of Puerto Rico.

Distribution Records: Central Aguirre, August 15, 1935; Santa Isabel, August 15, 1935; Ponce, October 3, 1935, No. 3; Guánica, October 9, 1935, No. 8; Mayagüez, November 14, 1935.

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[4] Numbers following a locality and date record refer to the author's record file maintained during the course of the work.

3. *Psorophora* (*Grabhamia*) *jamaicensis* (Theobald).

The larvae of this form are slightly larger than those of *P. pygmaea.* They are found in temporary surface pools and occasionally in roadside ditches. Usually, they are the only species present in a given pool although *Anopheles albimanus, Culex inhibitator, C. pilosus*, and *Uranotaenia lowii* have been taken with it.

The adults are large and vicious biters. They were taken in large numbers in certain of the horse traps, especially those along the seacoast at Mayagüez. Occasionally adults were taken in small numbers in light-trap collections.

Distribution Records: Mayagüez, August 22, 1935, August 30, 1935, September 17, 1935, No. 1, November 14, 1935, November 29, 1935, No. 1, November 30, 1935, LT.

4. *Aedes* (*Ochlerotatus*) *nubilus* (Theobald).

The larvae of this form were not found in the water taken from crab holes. Dr. Stone, however, was able to recognize the adult from collections of mosquitoes taken in the entrances to the holes. Other species in company with this form were *Culex janitor, Deinocerites cancer,* and *Aedes taeniorhynchus.*

Distribution Record: Dorado, September 1, 1935.

5. *Aedes* (*Ochlerotatus*) *tortilis* (Theobald).

This form was first recognized in horse-trap collections from Las Mesas (elevation 1,000 feet) in Mayagüez. During the period October 3–9, 1935, 198 mosquitoes were taken in 7 collections and 95 percent of these were *Aedes tortilis.* Later (November 1935) the same species was taken in a horse trap on Maricao Mountain (elevation 3,000 feet), and during 1936 they were found in horse-trap collections in the regions along the sea coast. This species apparently prefers higher altitudes and it is suspected that this is the form that frequently annoys men working in the mountain forests of Puerto Rico.

Although an intensive search was made for the larvae not one was located.

Distribution Records: Mayagüez, August 7, 1935, HT, October 4, 1935, HT, November 14, 1935, HT, May 2, 1936, HT; Maricao Insular Forest, November 2, 1935, HT; November 3, 1935, HT.

6. *Aedes* (*Taeniorhynchus*) *sollicitans* (Walker).

This species was taken in both the larval and adult stages at several places along the southern coastal of Puerto Rico. In no case, however, were larvae taken in coastal salt marshes, which is the usual habitat for this species. The larvae were first taken in

hoof-track pools along the edge of Lake Guánica. Although the water in the lake is only slightly brackish (25 parts Cl. to 100,000 parts of water), the water in the small pools adjacent to it becomes concentrated by evaporation. Some of these pools have a chlorine content as high as 900 parts per 100,000 parts of water. Large numbers of larvae of this species were found in this region at various times. The presence of this species in pools having a chlorine content not greater than 900 parts is considered unusual. In the tidal marshes of the eastern coast of the United Sates this species prefers to live in pools having a high chlorine content, it oftentimes being equal to, or greater than, that of coastal sea water. Other species were found breeding in pools with *sollicitans,* among them *Anopheles albimanus, Culex bahamensis,* and *C. nigripalpus.* The adults are active and attack freely at night and during the day.

Distribution Records: Guánica, October 25, 1935, January 23, 1936, No. 2, May 18, 1936; Aguirre, October 30, 1935, No. 2, October 31, 1935, No. 1; Guayama, October 31, 1935, No. 5; San Juan, October 4, 1930 (WAH).

7. *Aedes* (*Taeniorhynchus*) *taeniorhynchus* (Wiedemann).

The larvae of this species are found in pools of a semipermanent or permanent nature in the coastal plain region. Apparently they do not have any particular preference for any special kind of water since they were taken in clean, dirty, fresh, and brackish pools. Other species found with them in fresh water pools were *Anopheles albimanus* and *Culex nigripalpus.* In the brackish pools at Lake Guánica *C. bahamensis* and *A. albimanus* were associated with this species. The adults are quite numerous in certain regions and were taken in large numbers in two of the horse traps operated near the seashore at Mayagüez.

Distribution Records: Dorado, November 7, 1935 (WAH), September 1, 1935; Guánica, October 9, 1935, No. 1, October 25, 1935, No. 1; Mayagüez, August 24, 1935, HT, September 11, 1935, No. 1, November 14, 1935, HT; San Juan, October 1932 (WAH).

8. *Aedes* (*Finlaya*) *mediovittatus* (*Coquillett*).

The usual larval habitat of this species is tree holes. In Puerto Rico many suitable cavities containing water are found in the native mango trees. This species is not entirely restricted to tree holes, since in one case larvae were found associated with the larvae of *Aedes aegypti* breeding in stone crocks which were piled edgewise in a greenhouse at Mayagüez. The presence of these two species in this situation represents an overlapping of habitats. The larvae found

in tree holes are often associated with two species of predatory mosquito larvae, *Megarhinus portoricensis* and *Corethrella appendiculata.* The pH of water in these situations is usually very nearly neutral. The adults are conspicuously marked with white. They were taken in light traps in a few cases.

Distribution Records: Pueblo Viejo, August 31, 1935, No. 1; Mayagüez, September 18, 1935, No. 1, October 4, 1935, No. 2. November 7, 1935, No. 3, December 6, 1935, No. 1; Guayama, October 26, 1930 (WAH); Yauco, April 1932 (WAH).

9. *Aedes* (*Howardina*) *aegypti* (Linnaeus).

Aedes aegypti is one of the two species of mosquitoes that is nearly always found in the neighborhood of dwellings in Puerto Rico. In the poorer, thickly settled regions the rain water is saved either for drinking or washing or both. The receptacles used to collect the water, either barrels or cisterns, usually are not covered and they are therefore easily accessible to the females for depositing their eggs.

This species was taken in all parts of the coastal plains of Puerto Rico and in many of the towns high in the mountains.

The adults are fierce biters and attack freely and without warning during the day and early in the evening.

Distribution Records: Mayagüez, July 31, 1936, No. 4, August 1, 1935, No. 1, August 3, 1935, No. 1, August 22, 1935, No. 2, October 21, 1935, No. 1, October 21, 1935, No. 1, December 4, 1935, No. 1, February 15, 1936, No. 5, April 10, 1936, No. 2, April 9, 1936, No. 1; Rincón, August No. 4; Guánica, October 9, 1935, No. 2; Fajardo, November 13, 1935, No. 5 A; San Juan, December 19, 1935, No. 2, October 1, 1926 (WAH); Cataño, December 19, 1935, No. 4; Hormigueros, April 3, 1936, No. 1; San Germán, April 3, 1936, No. 3; Guayanilla, April 6, 1936, No. 1; Cabo Rojo, April 7, 1936, No. 1; Lajas, April 7, 1936, No. 8; Aguada, April 8, 1936, No. 3; Aguadilla, April 8, 1936, No. 7; San Sebastián, April 8, 1936, No. 10; Quebradillas, April 9, 1936, No. 4; Camuy, April 9, 1936, No. 6; Hatillo, April 9, 1936, No. 7; Arecibo, April 9, 1936, No. 8; Peñuelas, April 15, 1936, No. 1; Ponce, April 15, 1936, No. 2.

10. *Aedes* (*Ochlerotatus*) *condolescens* Dyar & Knab.

A form suspected to be this species was taken by sweeping an area covered with dead leaves in a deeply shaded wood in Mayagüez. An examination of the male genitalia substantiated this identification. The larva is unknown.

Distribution Record: Mayagüez, May 21, 1936.

11. *Aedes* (*Ochlerotatus*) *scapularis* (*Rondani*).

This species is represented by a single larva taken on the edge of a roadside ditch at Mayagüez. It was associated with *Dixa* sp., *Corethrella appendiculata,* and *Uranotaenia lowii.*

Distribution Record. Mayagüez, May 16, 1936, No. 1.

12. *Mansonia* (*Mansonia*) *titillans* (Walker).

Males and females of this form were taken in small numbers from the light trap at the Experiment Station in Mayagüez during the fall of 1935. No specimens were taken in horse traps, and it is not known if the females attack man or animals. The larvae were not taken.

Distribution Records: Mayagüez, September 26, 1935, LT. November 25, 1935, LT.

13. *Mansonia* (*Mansonia*) *indubitans* Dyar & Shannon.

This species previously was known only from adults. During these investigations the larvae were taken for the first time attached to the submerged stems of *Pistia stratiodes.* Larvae brought into the laboratory reattached themselves to stems of *Pistia* and developed to maturity. A description of the larva follows:

Description of the larva of M. indubitans: Length 6–7 mm. Head one-fourth wider than long; antenna (fig. 7) long and slender, longer than width of head, a large hair tuft at the middle of the basal portion, terminal portion long and slender with an articulation at the distal end, two long terminal setae present arising from end of basal portion equal in length to terminal portion of antenna. Head hairs small and in multiple tufts. Lateral comb at eighth segment of eight to ten scales arranged in a single row, each scale fringed outwardly with large spines. Air tubes (fig. 8) less than twice as long as wide, the basal portion broad, a terminal portion sharply attenuated with saw-like teeth on upper edge; a pair of hair tufts on lower portion of basal portion, a single pair of hairs on upper edge of tube at junction of basal and terminal portions; pecten absent. Anal segment nearly twice as long as wide, ringed by dorsal plate and covered with fine pilose setae; dorsal tuft of many long hairs, all joined at base; lateral hair, a small tuft of long hairs; ventral brush of long hairs. Anal gills four, pointed and shorter than anal segment. (Larval and pupal skins and reared male in the collection of the United States National Museum.)

The females were taken in numbers from light and horse traps. It is not known if they enter houses in search of blood. The records given below are the first for the West Indies.

Distribution Records: Lake Cartagena, November 16, 1935, HT, November 23, 1935, No. 5, HT; Sabana Grande, May 22, 1936, LT.

14. *Deinocerites cancer* (Theobald).

The larvae of this form develop in the water found in crab holes near the sea coast. The adults may be found resting in the mouths of crab holes during the day. Males have been taken from light traps at night, and females engorged with blood have been found in horse traps. The females have been observed also in houses at night.

Distribution Records: Dorado, September 1, 1935; Mayagüez, November 14, 1935, HT.; Central Aguirre, July 15, 1935.

15. *Culex* (*Mochlostyrax*) *pilosus* Dyar & Knab.

The larvae of this form were taken in a roadside ditch in association with many other larvae. The larvae rest on their backs on the bottom of the pool and when disturbed exhibit a peculiar wiggling motion of the hinder parts of the body which is different from that of any other tropical *Culex* encountered. The larvae were fairly numerous during the latter part of November 1935 but were not encountered again until May 1936. Larvae of *Uranotaenia* are nearly always found associated with this species and quite frequently *Anopheles albimanus* and *Psorophora jamaicensis* were present as well.

Distribution Records: Mayagüez, November 26, 1935, No. 1, November 27, 1935, No. 3, November 29, 1935, No. 1, May 31, 1936.

16. *Culex* (*Mochlostyrax*) *inhibitator* Dyar & Knab.

This species is one of the most abundant of the *Culex* group. It develops in roadside ditches, swampy areas, edges of ponds (fig. 4), and in both fresh and brackish water. In general, it is found in all types of clean water, rarely being found in water that is polluted with sewage (fig. 5). In one instance it was taken in water containing 770 parts of chlorine per 100,000 parts of water (Añasco River).

The adults of this species were taken in a horse trap at Lake Cartagena. No other evidence relative to their blood-sucking habits is available.

Distribution Records: Mayagüez, August 21, 1935, No. 3, November 29, 1935, No. 1, December 10, 1935, No. 3, January 8, 1936, No. 1, January 10, 1936, No. 1, January 15, 1936, No. 1, March 15, 1936, No. 1; Hormigueros, September 17, 1935, No. 3; Guánica, October 9, 1935, No. 4; Rincón, October 10, 1935, No. 5; San Anto-

nio, October 10, 1935, No. 1; Lake Cartagena, November 11, 1935, No. 4; Guanajibo, Mayagüez, November 7, 1935, No. 2; San Sebastián, January 17, 1936, No. 1; Dorado, February 1932, (WAH).

17. *Culex* (*Mochlostyrax*) *carcinophilus* Dyar & Knab.

Only the larval stage of this species was taken. It is reputed to develop in crab holes but these specimens were taken along the edge of Lake Cartagena in water containing a large amount of floating vegetation.

Distribution Records: Lake Cartagena, November 11, 1935, November 23, 1935.

18. *Culex* (*Melanoconion*) *atratus* Theobald.

The larvae of this species were taken in pools of a more or less permanent nature containing some vegetation. They were associated with *Anopheles albimanus* and *Uranotaenia* sp.

The adults were not recognized in house, light, or horse-trap collections.

Distribution Records: Mayagüez, August 22, 1935, No. 1, October 7, 1935, No. 1, October 8, 1935, No. 2, November 7, 1935, No. 4; Dorado, February 1932 (WAH), September 1, 1935, No. 4; San Juan, April 26, 1929 (WAH).

19. *Culex* (*Melanoconion*) *americanus* (Neveu-Lemaire).

The larvae of this species were taken in the leaf bases of the following three plants: (*a*) The bromeliad *Guzmania berteroniana:* (*b*) "malanga", *Caladium colocasia* (fig. 6); and (*c*) a plant without any common name, *Dieffenbachia sequine.* The bromeliads found in the mountainous regions of Puerto Rico are the most important and most abundant of the host plants mentioned above.

The water in the leaf bases of the bromeliads in which these larvae live always is acid. In some cases larvae were taken from bromeliad water having a pH of 3.8. Usually, however, the pH range is between 4 and 6. Other mosquito larvae present in bromeliad leaf bases are *Megarhinus protoricensis, Wyeomyia mitchellii,* and *Corethrella appendiculata.*

The adults were not taken in horse-trap collections in regions where the larvae of this species were abundant, and it is assumed, from this, that they do not usually attack warm-blooded animals.

Distribution Records: Maricao, August 15, 1935, No. 1, August 25, 1935, No. 1, October 13, 1935, No. 1, October 28, 1935, No. 1, November 7, 1935, No 1, January 28, 1936, No. 10, May 5, 1936, No. 1, May 21, 1936; Luquillo National Forest, March 24, 1936, No. 1, May 21, 1936, No. 1.

20. *Culex* (*Culex*) *bahamensis* Dyar & Knab.

The larvae of this species are restricted to brackish water. On one occasion the water in a large pool at Salinas appeared black because of the large number of larvae present. The larvae also were taken in the hoof-track pools along the edge of Lake Guánica in water having a chlorine range of from 195 to 900 parts per 100,000 of water. Species associated with *bahamensis* in brackish water pools were *Aedes sollicitans*. *Anopheles albimanus* and *Culex nigripalpus*.

Distribution Records: Salinas, October 31, 1935, No. 8; Guánica, January 23, 1936, No. 1; Dorado, August 15, 1930 (WAH.)

21. *Culex* (*Culex*) *habilitator* Dyar & Knab.

The larvae of this species are able to develop in either fresh or brackish water. They were taken in large numbers from brackish pools (185 parts Cl per 100,000) along the Añasco River and in the brackish hoof-track pools at Lake Guánica. They were also taken in the swampy fresh-water areas in Mayagüez. Other larvae associated with this species were *Anopheles albimanus* and *Uranotaenia lowii*.

During the day, the adults may be found resting under dried leaves in shaded places in the forest. Their feeding habits were not determined.

Distribution Records: Mayagüez. July 27, 1935, No. 1, August 21, 1935, No. 1, May 7, 1936, No. 1; Ensenada, October 9, 1935, No. 1, October 17, 1935. No. 1; Guánica, October 9, 1935, No. 5; Dorado, October 1, 1930 (WAH).

22. *Culex* (*Culex*) *nigripalpus* Theobald.

This species is probably the most abundant of all tropical forms of *Culex*. It is found breeding in large numbers in the open country and in the towns, in fresh and brackish pools and in clean and sewage-polluted waters. The larvae have been found associated with *Uranotaenia lowii, Corethrella appendiculata, Aedes taeniorhynchus, Anopheles albimanus, A. grabhamii, Culex quinquefasciatus, Aedes sollicitans, Anopheles crucians*, and *Culex bahamensis*.

The adults rarely enter houses.

Distribution Records: Mayagüez, July 8, 1935, No. 1, July 25, 1935, No. 2, August 22, 1935, No. 3, August 28, 1935, No. 2, September 7, 1935, No. 1, September 9, 1935, No. 1, September 11, 1935, No. 2, September 13, 1935, No. 1, September 18, 1935, No. 2, September 29, 1935, No. 1, October 7, 1935, No. 2, December 10, 1935, No. 4, December 14, 1935, No. 2; Añasco, August 20, 1935, No. 5. August 19, 1935, No. 1, September 19, 1935, No. 3; Hormigueros,

September 17, 1935, No. 4; Guánica. October 9, 1935, No. 6, January 23, 1936, No. 2; Ensenada, October 17, 1935, No. 1, October 25, 1935, No. 4 Las Marías, January 17, 1936, No. 2; Dorado, October 1930 (WAH).

23. *Culex* (*Culex*) *janitor* Theobald.

This form is known only from adults collected in the mouths of crab holes. Dr. Hoffman has taken the larvae in crab holes at Pueblo Viejo.

Distribution Records: Dorado, September 1, 1935; Mayagüez, April 29, 1936, No. 3; Pueblo Viejo, November 2, 1935 (WAH).

24. *Culex* (*Culex*) *secutor* Theobald.

The larvae of this species appear to prefer water which is cool, since they are found in permanent pools at high altitudes or in deeply shaded pools in the lowlands. They were taken in the same pools with the larvae of *Chaoborus brasiliensis*.

Distribution Records: Mayagüez, October 17, 1935, No. 1, February 15, 1936, No. 6; Maricao, January 28, 1935, No. 9; Luquillo National Forest, April 12, 1936.

25. *Culex* (*Culex*) *quinquefasciatus* Say.

This species is probably the most abundant form found in the towns and cities of Puerto Rico. It is found around habitations in nearly all parts of Puerto Rico with the exception of certain high mountainous areas. It is able to develop in clear water or in water heavily laden with sewage. Street gutters (fig. 1), drainage ditches (fig 2), tin cans, etc., are suitable places where water may collect and breeding result. It usually does not have the association of other mosquito larvae although rarely it is found with *Anopheles albimanus*, *Aedes aegypti*, and *Culex nigripalpus*.

The adults enter houses in great numbers in search for blood, and from the standpoint of annoyance it is the most important species. It is probably the only mosquito vector of filariasis in Puerto Rico. This disease is of some importance on the Island.

Distribution Records: Mayagüez, July 10, 1935, No. 1, July 4. 1935, No. 1, July 11, 1935, No. 2, August 1, 1935, No. 2, August 18, 1935, No. 1, August 21, 1935, No. 4, August 27, 1935, No. 1, September 12, 1935, No. 1, September 29, 1935, No. 1, December 10, 1935, No. 5; December 11, 1935, No. 1, December 11, 1935, No. 2, December 11, 1935, No. 3, December 9, 1935, No. 1, December 13, 1935, No. 4, December 14, 1935, No. 3, January 4, 1936, No. 1, February 15, 1936, No. 5, February 19, 1936, No. 1; Isabela, August 19, 1935, No. 1; Rincón, August 26, 1935, No. 2; Fajardo, Novem-

ber 13, 1935, No. 5; San Juan, November 12, 1935, No. 5, December 19, 1935, No. 1, October 1, 1926 (WAH); Cataño, December 19, 1935, No. 5; Maricao, January 6, 1936, No. 1, April 14, 1936, No. 1; Adjuntas, January 6, 1936, No. 4; Jayuya, January 6, 1936, No. 4; Hormigueros, April 3, 1936, No. 2; Guayanilla, April 6, 1936, No. 2; Sabana Grande, April 6, 1936, No. 4; Añasco, April 7, 1936, No. 4; Ponce, April 13, 1936, No. 4.

26. *Megarhinus (Megarhinus) portoricensis* Roeder.

The larva of this species was the largest of any taken in Puerto Rico. Its habitat is restricted to tree holes in association with *Aedes mediovittatus* and in leaf bases of bromeliads in association with *Culex americanus* and *Wyeomyia mitchellii.* It is a predator on other mosquito larvae and, if necessary, cannibalistic. Its restricted habitat does not allow its predacious habit to be of any significance in the general Puerto Rican mosquito problem.

A single male was taken by M. R. Smith in a coffee grove in Mayagüez during midday on September 18, 1935.

Distribution Records: Mayagüez, September 18, 1935, No. 1. December 10, 1935, No. 1.

27. *Uranotaenia sapphirina* (Osten-Sacken).

Although *Uranotaenia* larvae are very common in all parts of the coastal plain of Puerto Rico, the two common species cannot be readily separated on larval characters. On the basis of rearings and light-trap collections it appears that this species is present only in small numbers.

The adults do not attack man.

Distribution Records: Cabo Rojo, November 18, 1935, No. 1, Mayagüez, November 8, 1935.

28. *Uranotaenia lowii* Theobald.

This species appeared with regularity and in greater numbers than *U. sapphirina* both in light-trap collections and in reared material during the year. The larvae of this group prefer the water containing much vegetation. They are found in considerable numbers in almost all open-country situations. In one or two cases they were taken in brackish water pools.

As far as known the adults do not attack man or animals.

Distribution Records: Mayagüez, August 22, 1935, No. 1, September 18, 1935, No. 2, October 1, 1935, No. 1, October 8, 1935, No. 3, November 26, 1935, No. 1; Guánica, October 9, 1935, No. 5, October 9, 1935, No. 8; Rincón, October 10, 1935, No. 5; Lake Cartagena, November 11, 1935, No. 4.

29. *Anopheles* (*Nyssorhynchus*) *albimanus* Wiedemann.

This species is the most abundant of the Puerto Rican anophelines. It is found in all parts of Puerto Rico, yet the most suitable conditions for its development are found in the coastal plain.

The larvae are commonly found in roadside, irrigation (fig. 3), or drainage ditches, in overnight reservoirs (fig. 5), in swamps, and along the margins of streams, rivers, ponds, (fig. 4) and lakes. They also have been found in street gutters, tin cans, and water barrels, but the indications are that they prefer situations in open country. They appear to breed with equal ease in brackish and in fresh water, as they were taken in water having 950 parts of chlorine per 100,000 parts of water.

The adults are active only at night and as many as 1,000 were taken in one horse trap in one night. During the day they remain in hiding and consequently little is known of their diurnal activities. In a few cases the females were recovered by sweeping and in one case a female was taken from the mouth of a crab hole.

Its importance as a carrier of the causative organism of malaria cannot be over-estimated.

Distribution Records: Mayagüez, July 8, 1935, No. 2, July 10, 1935, No. 3, July 31, 1935, No. 1, August 14, 1935, No. 1, August 21, 1935, No. 2, August 22, 1935, No. 1, September 11, 1935, No. 1, September 17, 1935, No. 1, September 29, 1935, No. 1, October 4, 1935, No. 1, October 7, 1935, No. 1. October 8, 1935, No. 1, November 7, 1935, No. 4, November 26, 1935, No. 1, November 27, 1935, No. 3, November 29, 1935, No. 1, December 10, 1935 No. 3, December 13, 1935, No. 1, January 8, 1936, No. 2, January 10, 1936, No. 1, February 15, 1936, No. 5, March 15, 1936, No. 1, March 16, 1936, No. 3; Rincón, August 20, 1935, No. 4; Hormigueros, August 16, 1935, No. 1, September 17, 1935, No. 2; Isabela, August 19, 1935, No. 3; Añasco, August 20, 1935, No. 4, September 19, 1935, No. 1; Pueblo Viejo, August 31, 1935, No. 3, December 18, 1935, No. 1; Río Piedras, August 31, 1935, No. 4; Dorado, September 1, 1935, No. 1; Toa Alta, September 1, 1935, No. 5; Vega Baja, September 2, 1935, No. 1; November 12, 1935, No. 3; Manatí, September 2, 1935, No. 2; Barceloneta, September 2, 1935 No. 3; Ponce, October 3, 1935, No. 2; Guánica, October 9, 1935, No. 5, October 25, 1935, No. 1; January 23, 1936, No. 1; Ensenada, October 17, 1935, No. 1; Aguada, October 10, 1935, No. 3; Guánica, October 25, 1935, No. 1; Aguirre, October 30, 1936, No. 3; October 31, 1935, No. 1; Guayama, October 31, 1935, No. 4; Arroyo, October 31, 1935, No. 5; Salinas, October 31, 1935, No. 6; Quebradillas, November 8, 1935,

No. 1; Hatillo, November 11, 1935, No. 1; Boquerón, November 11, 1935, No. 1; Lake Cartagena, November 11, 1935, No. 4; Arecibo, November 12, 1936, No. 1; Manatí, November 12, 1935, No. 2; Bayamón, November 12, 1935, No. 4; December 18, 1935, No. 2; San Juan, November 12, 1935, No. 6; Carolina, November 13, 1935, No. 1; Río Grande, November 13, 1935, No. 2; Mameyes, November 13, 1935, No. 3; Luquillo, November 13, 1935, No. 4; Fajardo, November 13, 1935, No. 6; Ceiba, November 13, 1935, No. 7; Naguabo, November 13, 1935, No. 8; Humacao, November 13, 1935, No. 9; Yabucoa, November 13, 1935, No. 10; Maunabo, November 7, 1935, No. 4; Cataño, December 19, 1935, No. 3; Adjuntas, January 6, 1936, No. 3; Las Marías, January 17, 1935, No. 2.

30. *Anopheles* (*Anopheles*) *crucians* (Wiedemann).

This species is represented by a single larva taken in brackish water in a hoof print at Lake Guánica. This constitutes the first record of the species in Puerto Rico.

Distribution Record: Guánica, January 23, 1935, No. 2.

31. *Anopheles* (*Anopheles*) *grabhamii* Theobald.

In so far as abundance in Puerto Rico is concerned this species ranks second among the anophelines. The larvae are found in fresh and in slightly brackish water in habitats similar to those in which larvae of *A. albimanus* are found.

The adults were taken in horse traps and occasionally in light trap and net collections.

Distribution Decords: Dorado, September, 1935, No. 3; Mayagüez, December 10, 1935, No. 4.

32. *Anopheles* (*Anopheles*) *vestitipennis* Dyar & Knab.

The larvae of this species were not taken, but adults were present in various horse-trap collections. In abundance it ranks third among the anophelines.

Distribution Records: Mayagüez, September 17, 1935, HT, October 15, 1935, HT; Cabo Rojo, December 16, 1935, HT, January 4, 1936, HT.

33. *Corethrella appendiculata* Grabham.

The larva of this species, although small in size, is an effective predator on first-and second-stage *Culex* larvae. It is found in many open-country habitats having clean water, in crab holes, and in large numbers in the leaf bases of bromeliads.

It probably is of little value in reducing the numbers of mosquitoes attacking man.

Distribution Records: Mayagüez, August 1, 1935, No. 3, August 21, 1935, No. 3, September 9, 1935, No. 1, September 18, 1935, No. 1, November 27, 1935, No. 1; Maricao, August 25, 1935, No. 1, October 13, 1935, No. 1, January 28, 1936, No. 10; Dorado, September 1, 1935, No. 2.

34. *Chaoborus brasiliensis* Theobald.

Adults of this species were taken in large numbers from light-trap collections, yet the larvae were encountered in only one instance. The larvae were taken in a pool formed by a spring in heavily shaded woods. Other larvae in the pool were *Culex secutor* and *C. inhibitator*. Although the larva is predacious it probably does not materially aid in reducing the number of mosquitoes attacking man.

The records below are the first for the West Indies.

Distribution Records: Mayagüez, September 10, 1935, LT, February 15, 1936.

A Key to the Species of Mosquitoes[5] Occurring in Puerto Rico

Table of Genera

ADULTS

1. Base of hind coxa in line with upper margin of lateral metasternal sclerite	2
Base of hind coxa distinctly below upper margin of lateral metasternal sclerite	3
2. Tuft of setae present on metanotum	*Wyeomyia*
Setae absent on metanotum	*Megarhinus*
3. Scutellum crescent shaped	*Anopheles*
Scutellum trilobed	4
4. Anal vein extending beyond fork of cubitus	5
Anal vein ending opposite or at base of cubital fork	*Uranotaenia*
5. Postspiracular setae present	6
Postspiracular setae absent	8
6. Spiracular setae present	*Psorophora*
Spiracular setae absent	7
7. Wing scales narrow	*Aedes*
Wing scales broad	*Mansonia*
8. Antennae longer than proboscis	*Deinocerites*
Antennae not longer than proboscis	*Culex*

LARVAE

1. Eighth segment of abdomen provided with a distinct elongate dorsal siphon or respiratory tube	2
Eighth segment without a distinct elongate dorsal siphon	*Anopheles*
2. Anal segment without ventral brush	*Wyeomyia*
Anal segment with ventral brush	3

[5] Only the Culicinae or biting mosquitoes are considered.

3. Eighth segment laterally without pecten, having a plate with two coarse setae ---------- *Megarhinus*
Eighth segment laterally with pecten consisting of small teeth ---------- 4
4. Air tube without pecten ---------- *Mansonia*
Air tube with pecten ---------- 5
5. Air tube with several pairs of ventral tufts ---------- *Culex*
Air tuve with a single pair of tufts ---------- 6
6. Head elongate, elliptical ---------- *Uranotaenia*
Head nearly circular or transverse ---------- 7
7. Mandible projecting laterally ---------- *Deinocerites*
Mandible concealed ---------- 8
8. Anal segment ringed by dorsal plate with hair tufts piercing ring ---------- *Psorophora*
Anal segment not ringed by plate, or if ringed the hair tufts posterior to the ring ---------- *Aedes*

Table of Species of Psorophora

ADULTS

1. Femora and tibiae distinctly white speckled, first tarsal segment with a mesial white band ---------- *jamaicensis*
Femora and tibiae scarcely white speckled, first tarsal segment without mesial white band ---------- *pygmaea*

LARVAE

1. Head hairs single ---------- *pygmaea*
Head hairs multiple ---------- *jamaicensis*

Table of Species of Aedes

ADULTS

1. Tarsi not white marked ---------- 2
Tarsi white marked ---------- 5
2. Mesonotum marked with gold ---------- *tortilis*
Mesonotum marked with silver ---------- 3
3. Silver on mesonotum in a broad stripe not reaching scutellum ---------- 4
Silver on mesonotum in a broad or narrow line reaching scutellum ---------- *nubilus*
4. Abdomen with a median whitish-brown longitudinal band ---------- *scapularis*
Abdomen without such a band ---------- *condolescens*
5. Proboscis of female ringed with white ---------- 6
Proboscis of female not ringed with white ---------- 7
6. Abdomen with a longitudinal dorsal stripe ---------- *sollicitans*
Abdomen without a longitudinal dorsal stripe ---------- *taeniorhynchus*
7. Mesonotum dark with lyre-shaped silvery markings ---------- *aegypti*
Mesonotum light with three central narrow silvery lines ---------- *mediovittatus*

LARVAE

1. Anal segment ringed by plate ---------- 3
Anal segment not ringed by plate ---------- 2
2. Brush of anal segment with a more or less well developed triangular chitinous plate ---------- *mediovittatus*
Without this structure ---------- *aegypti*

3. Air tube with tuft within pecten — 4
   Air tube with tuft beyond pecten — 5
4. Lateral comb of eighth segment of a few scales — *nubilus*
   Lateral comb of eighth segment of many scales in a triangular plate — *tortilis*
5. Comb scales pointed at tip, thorn shaped — *sollicitans*
   Comb scales with feathered tips — 6
6. Anal segment short, gills budlike — *taeniorhynchus*
   Anal segment normal, gills moderate — *scapularis*
   The larva of *A. condolescens* is unknown.

Table of Species of Mansonia

ADULTS

1. Large reddish forms with palpi over one-third as long as proboscis — *titillans*
   Small black and white forms with palpi not as long as one third of proboscis — *indubitans*

LARVAE

1. Antenna stout with a terminal digit drawn out but distinctly smaller than the antenna itself — *titillans*
   Antenna slender with a terminal digit of the same size as antenna and continuous with it — *indubitans*

Table of Species of Uranotaenia

ADULTS

1. Tarsi all darky colored — *sapphirina*
   Tarsi marked with white — *lowii*

LARVAE*

1. Anal gills pointed — *sapphirina*
   Anal gills blunt — *lowii*

Table of Species of Culex

ADULTS

1. Vertex of head with narrow curved scales — 2
   Vertex of head often with small flat scales or many erect forked scales, generally with the tarsi unmarked — 8
2. Tarsal joints white marked — 3
   Tarsal joint black — 7
3. Proboscis of female with a distinct central white ring — *bahamensis*
   Proboscis of female without a distinct white ring — 4
4. Proboscis of female with a broad pale area beneath, which may be continued on the upper side as a very narrow ring at about the outer third — *habilitator*
   Proboscis entirely black — 5
5. Abdomen with basal segmental white bands widening on the sides — some specimens of *nigripalpus*
   Abdomen without basal segmental bands — 6

* Final determination of the species in this genus must depend upon an examination of the adult.

6. Femora whitish below basally, occiput without erect black bristles---- *secutor*
   Femora entirely whistish below, occuput with erect black bristles---- *janitor*
7. Mesonotum with narrow curved scales-------------------- *quinquefasciatus*
   Menosotum with fine hair-like scales-------------------------- *nigripalpus*
8. Palpi over one-third the length of proboscis-------------------- *americanus*
   Palpi less than one-third the length of proboscis-------- *pilosus, inhibitator, carcinophilus, atratus*

LARVAE

1. Lateral comb of eighth segment consisting of spines in a single row -- *pilosus*
   Lateral comb with many scales in a triangular patch------------------- 2
2. Antennae uniformly shaped, apical portion not more slender------------ 3
   Antennae with the apical portion more slender than the basal portion--- 4
3. Abdominal hairs in coarse tufts------------------------------- *americanus*
   Abdominal hairs normal, two basal tufts of tube within pecten----- *janitor*
4. Anal gills only two--------------------------------------- *bahamensis*
   Anal gill four--- 5
5. Air tube with four or more paired tufts, the subapical one moved out of line at outer third of tube--- 6
   All of the tufts on air tube in line--------------------------------- 8
6. Air tube over five times as long as wide, without marked tapering------ 7
   Air tube less than five times as long as wide, tapering terminally, subfusiform-- *quinquefasciatus*
7. Air tube about eight times as long as wide, with short three-haired tufts-- *habilitator*
   Air tube about seven times as long as wide or less, hairs of tube often single --- *nigripalpus*
8. Air tube with long well defined tufts--------------------------------- 9
   Air tube with small double hair tufts----------------------- *carcinophilus*
9. Body spicular pilose--- 10
   Body glabrous--- *secutor*
10. Hair tufts on tube all of about the same length----------------- *atratus*
    Hair tufts on tube with the basal one long, the rest progressively shorter--- *inhibitator*

Culex antillum-magnorum Dyar is not considered to be a valid species but a form of *C. americanus* and, therefore, is not included in this key.

TABLE TO SPECIES OF ANOPHELES

ADULTS

1. Tarsi marked with white--- 2
   Tarsi dark--- *crucians*
2. White markings on hind tarsi different from those of fore and mid tarsi -- *albimanus*
   White markings on hind tarsi similar to those of fore and and mid tarsi 3
3. Wing scales distinctly inflated---------------------------------- *grabhamii*
   Wing scales narrow and linear---------------------------- *vestitipennis*

LARVAE

1. Teeth of comb alternatingly long and short .... *vestitipennis*
   Teeth of comb both long and short, irregular 2
2. Dorsal float hairs present on abdominal segments 1–7 .... *albimanus*
   Dorsal float hairs present on abdominal segments 2–7 3
3. Anterior pair of float hairs smaller than others .... *crucians*
   Float hairs all equal in size .... *grabhamii*

The following genera are represented by a single species in Puerto Rico: *Wyeomyia, Magarhinus,* and *Deinocerites.*

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FIG. I.—Street culvert at Fajardo found to contain larvae of *Culex quinquefasciatus*.

FIG. 2.—A drainage canal in one of the densely populated sections of Mayagüez which contained large numbers of *Culex quinquefasciatus*.

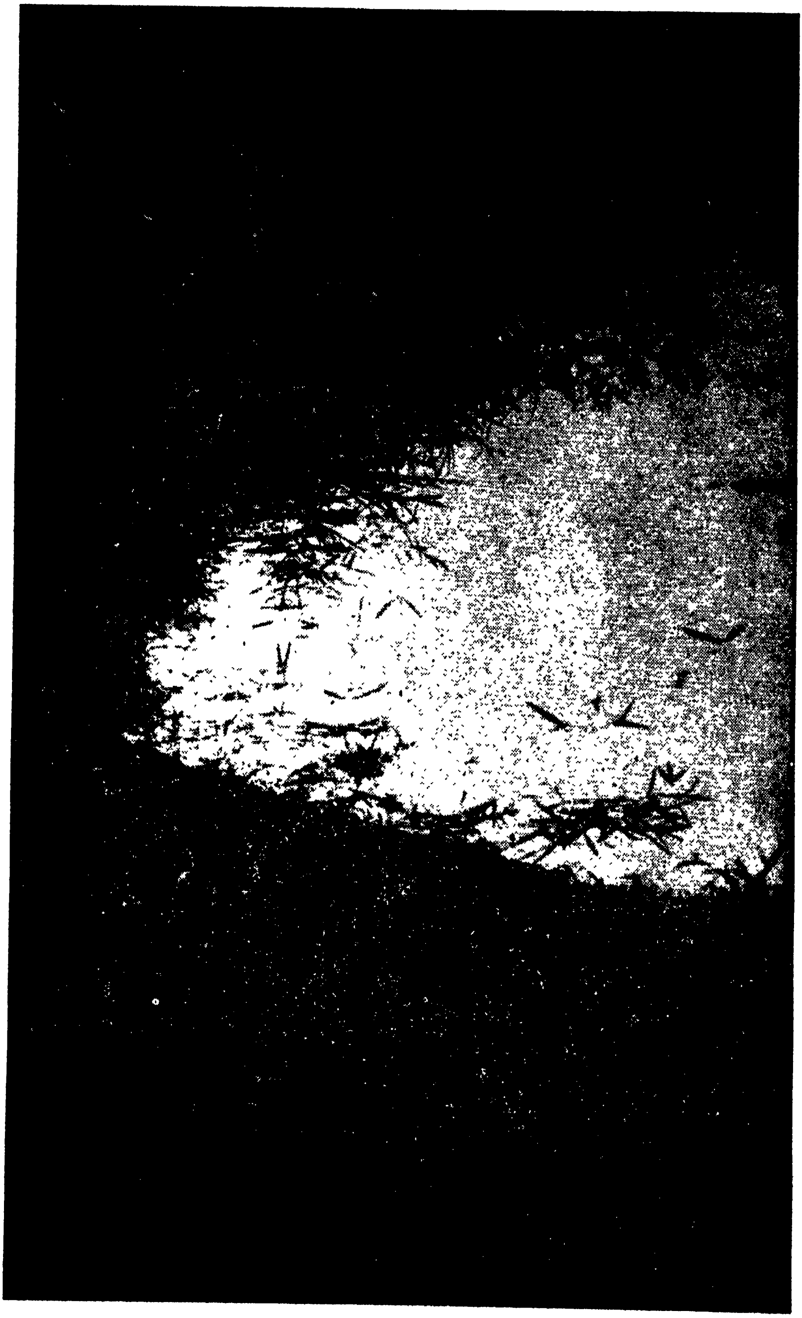

FIG. 3.—A secondary irrigation ditch containing large numbers of the larvae of *Anopheles albimanus*. Mayagüez, P. R.

FIG. 4.—A small pond well stocked with fish at Mayagüez found to contain larvae of *Anopheles albimanus* and *Culex inhibitator* along its grassy margins.

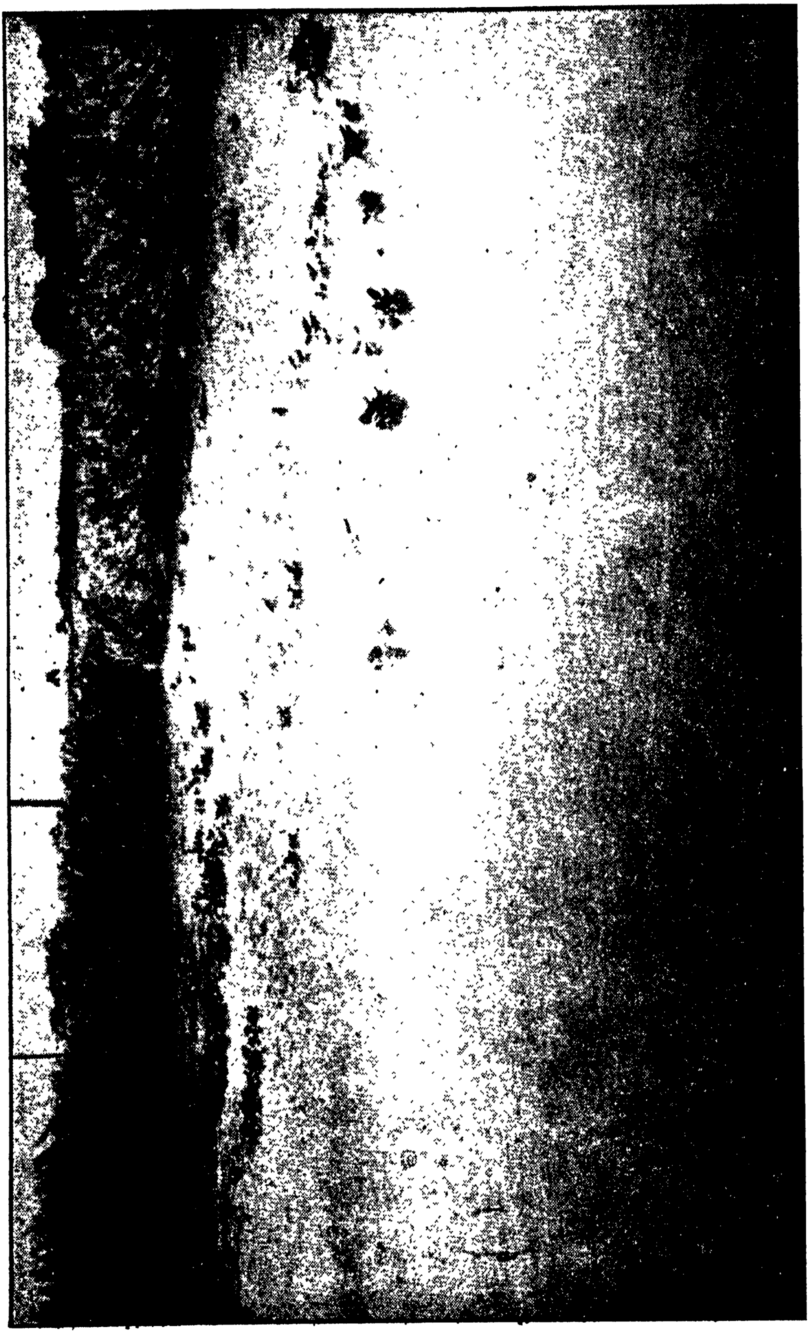

FIG. 5.—An overnight reservoir near Lake Cartagena containing larvae of *Anopheles albimanus*, *Culex inhibitator* and *Uranotaenia* spp.

FIG. 6.—Larvae of *Culex americanus* were found in the leaf bases of *Caladium colocasia*, commonly known as "malanga."

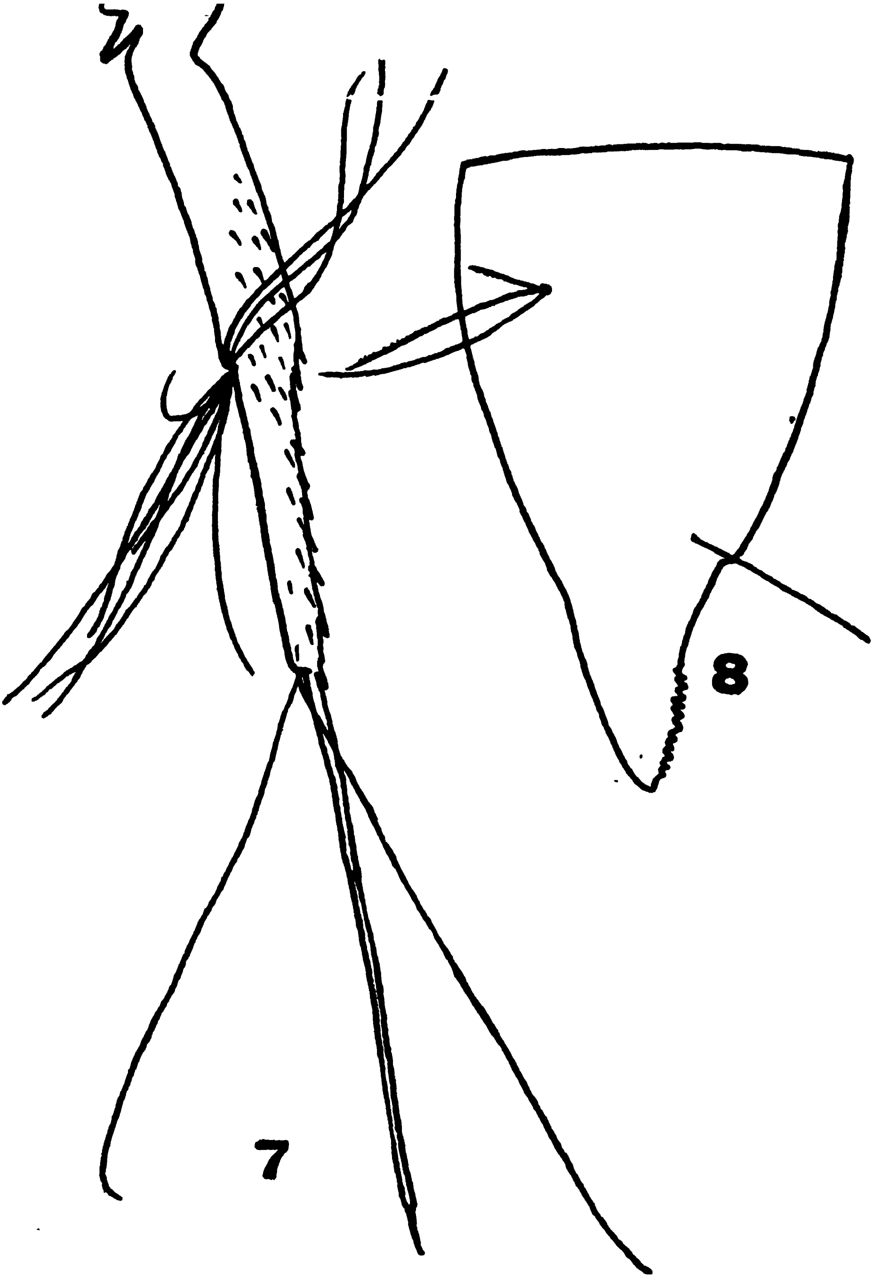

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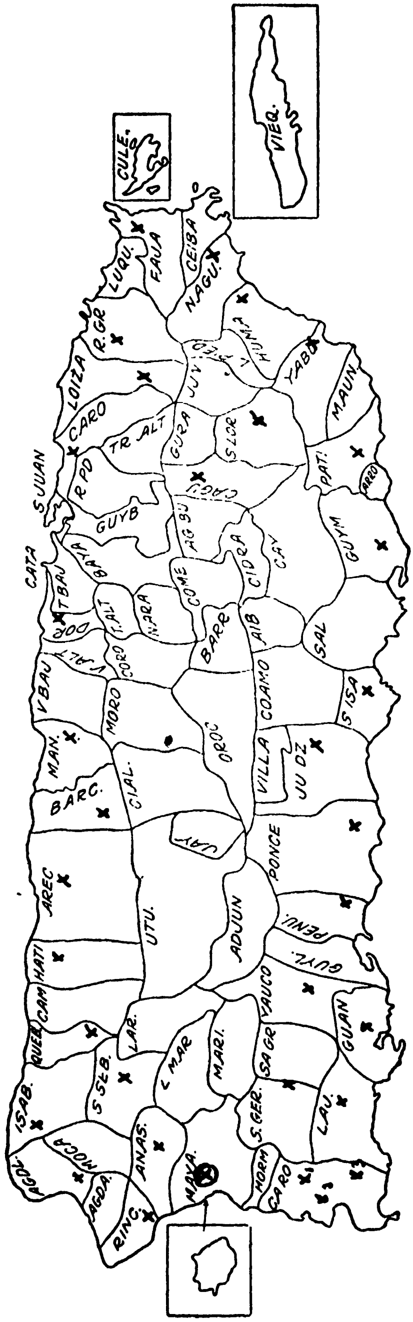
FIG. 7.—*Mansonia (Mansonia) indubitans:* **Antenna of larva.**
FIG. 8.—*Mansonia (Mansonia) indubitans:* **Air tube of larva.**



Map of Puerto Rico, showing locations sampled.

DAMAGE TO SEA ISLAND COTTON BY THE WEST INDIAN BLISTER MITE (*ERIOPHYES GOSSYPII* BANKS[1]) IN PUERTO RICO

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In Puerto Rico the West Indian blister mite constitutes one of the major cotton pests. In 1936 a few fields were completely destroyed and many others were severely damaged as a result of the attack of this mite. Damage was found to be most severe in fields in which the attack began on the young growing plants. In such cases the development of fruiting forms may be entirely prevented.

Serious damage to cotton by this pest has been reported from several widely separated areas. In India Thakar and Desai (**1**) report that this mite was first recorded in the year 1900, as a pest of cotton at Surat, the damage being as much as 50 per cent, and that since that date it has caused serious injury to cotton almost annually. In the West Indies Ballou (**2**) reports that this mite first occurred as a cotton pest in 1903, in Montserrat, and that soon afterwards it was found attacking wild and cultivated cotton in all the other islands of the Leeward and Windward groups and appeared in Barbados in 1912. During a visit to the Virgin Islands in 1931, U. C. Loftin was informed by former cotton growers that the blister mite had been known as a cotton pest for many years and was one of the principal "diseases" against which the ordinance passed by the Colonial Council of St. Croix in 1911 regulating the dates of planting and cleaning of fields was directed. The date of its first occurrence as a cotton pest in Puerto Rico is unknown but its presence was established in 1920 when Quarantine No. 47 of the United States Federal Horticultural Board against this mite was promulgated. According to Rainwater (**3**), "This cotton pest was not known to occur in the United States prior to June 1932, when U. C. Loftin collected it from wild cotton at Key Largo, and from dooryard plantings of Sea Island cotton in Key West." It is not known to occur in any section of the United States except southern Florida.

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[1] Order Acarina, family Eriophydae. Determined by H. E. Ewing.

[2] In cooperation with the Puerto Rico Experiment Station of the United States Department of Agriculture.

[3] These studies were made possible by funds allotted to this bureau during 1935–36 under Puerto Rico (sugar-processing) tax fund order No. 2.

In Puerto Rico the West Indian blister mite was found during 1935 and 1936 in all cotton-growing districts along the northern coast. In November 1936, late in the season, every field in this region was found heavily infested. In addition, a light infestation

FIG. 1.—Young cotton plant showing characteristic injury by the West Indian blister mite (*Eriophyes gossypii* Banks). Lack of fruiting branches and forms, distorted and crumpled leaves, and distorted growth are very noticeable. Plant height, 16 inches. Isabela, P. R., May 16, 1936.

was found on cultivated cotton at Boquerón on the southern coast. In May 1936 wild cotton trees at Corozal, San Juan, and Naranjito were found heavily infested.

Nature of Injury.—Characteristic injury to cotton as a result of the feeding habits of the West Indian blister mite is shown in figure 1. This mite attacks all parts of the cotton plant except the roots. The invasion begins on the young fruiting buds which are located in the axils of the leaves. The external indication of attack is a distorted or crumpled appearance of the affected parts, which have a growth of fine, short, white hair. An extensive proliferation of hair, especially on the lower surface of the leaf, is also noted. On the leaves the mites are mostly found on the lower surface, sucking the plant juices from the outside, causing a chlorosis of the tissues on the upper and lower epidermis. The palisade cells of the affected leaves fail to develop their normal length, being about one-third the length of palisade cells not affected by gall formation. The small white blisters are evidently caused by the irritation set up by these mites and result in hypertrophy of the affected part. The most noticeable injuries to heavily infested plants are the crumpled leaves, distorted growth, and lack of fruiting branches and forms. The mites no doubt destroy the buds of these branches and forms, preventing their development. Later on small leaves develop where the fruiting branches normally form, and as a result many small leaves with short petioles are borne along the main stem. Severely affected squares do not open into normal flowers because the petals become so tightly bound together by overgrowth that they can not separate from one another. Abnormal shedding of the squares or young bolls was not noted as a result of mite attack.

Extent of injury.—In order to show the extent of injury caused to cotton plants by this pest, counts were made of the number of fruiting branches, squares, bolls, and blooms and the plant height on plants in each of three different groups. Since the infestation was very uneven and adjacent plants in the same row were affected to different degrees, plants were selected at random and divided into three groups according to the degree of infestation, namely, none or light, medium, and heavy. Counts of this nature were made on two different occasions, April 20 and May 6. The field contained about 3 acres. The distance between plants and number of plants per hill varied considerably but the sandy soil appeared to be uniform.

The results of counts made on the above-mentioned plots to determine the amount of damage to Sea Island cotton by this pest are shown in table 1. It will be noted that the number of fruiting

branches, squares, bolls, and blooms, and plant height varied inversely as the degree of infestation. Large differences in the number of fruiting branches, squares, bolls, and blooms per plant were especially noted between the heavily and lightly or noninfested plants. On April 20 the differences between the average number of fruiting branches and forms per plant on the heavily and the lightly or noninfested plants were as follows: Fruiting branches 7.81, squares 9.33, bolls 1.54, and blooms 0.25. The average difference in plant height on this date was 5.85 inches. The average number of fruiting branches and forms per plant on the medium infested plants was about one-half the number found on the lightly or noninfested plants. At this time, 100 plants were examined in each group.

On May 6 the differences between the average number of fruiting branches and forms per plant on the heavily and lightly or noninfested plants were as follows: Fruiting branches 6.98, squares 9.15, bolls 4.39, and blooms 0.44. The average difference in plant height was 5.44 inches. On this date the difference between the average number of bolls per plant on the heavily and lightly or noninfested plants had decidedly increased over that of the examination made on April 20. However, the average number of fruiting branches and forms per plant on the medium infested plants on this date was only slightly less than on the lightly or noninfested plants.

In order further to confirm the foregoing observations, similar counts were made in two adjacent fields. A plot of 100 plants was staked off in each field. The number of fruiting branches, squares, and bolls, and the plant height in each of these plots were recorded bimonthly from April 15 to July 10, 1936. At the beginning of these observations the infestation on one plot was heavy while on the other plot it was light. However, the infestation gradually increased in the latter plot, and by July 10 became rather heavy. Therefore the counts were discontinued on that date. Other than the difference in the degree of infestation of this mite on the two plots, all other factors appeared to be uniform. The results of these examinations are shown in table 2 and graphically illustrated in figures 2 and 3. It will be noted that large differences were found in the number of fruiting branches, squares, and bolls on the lightly and heavily infested plots. As shown in figure 2, the difference in the number of fruiting branches between these two plots progressively increased at each consecutive bimonthly examination. The average difference per plant between the number of fruiting branches on

TABLE 1.—RESULTS OF EXAMINATION TO DETERMINE DAMAGE CAUSED BY THE WEST INDIAN BLISTER MITE (*ERIOPHYES GOSSYPII*) TO SEA ISLAND COTTON, ISABELA, P. R., 1936

Degree of infestation	Average number of fruiting branches on—		Average number of squares on—		Average number of bolls on—		Average number of blooms on—		Average plant height (inches) on—		Number of plants examined on—	
	April 20	May 6	April 20	May 6	April 20	May 6	April 20	May 6	April 20	May 6	April 20	May 6
None or light	9.00	10.19	10.62	11.69	1.54	5.40	0.28	0.50	16.23	18.29	100	52
Medium	5.44	9.29	7.45	11.07	.14	3.21	.09	.48	13.45	18.06	100	75
Heavy	1.19	3.21	1.29	2.54	.00	1.01	.03	.06	10 38	12.85	100	100

the lightly and heavily infested plots was 3.12 and ranged from 1.69 on April 15 to 5.27 on June 24. All fruiting branches were counted on each plot whether it was bearing fruiting forms or not. If only the fruiting branches bearing forms had been counted on each plot, these differences would have been much greater.

TABLE 2.—RESULTS OF EXPERIMENT TO DETERMINE DAMAGE CAUSED BY THE WEST INDIAN BLISTER MITE (ERIOPHYES GOSSYPII) TO SEA ISLAND COTTON, ISABELA, P. R., 1936

Date examined	Average number[1] of fruiting branches on—		Average number[1] of squares on—		Average number[1] of bolls on—		Average plant height (inches)	
	Lightly infested plot	Heavily infested plot	Lightly infested plot	Heavily infested plot	Lightly infested plot	Heavily infested plot	Lightly infested plot	Heavily infested plot
April 15	4.33	2.64	5.83	3.53	0.09	0.01	9.72	9.72
May 6	6.74	4.30	5.9C	4.15	3.01	1.36	14.32	13.65
May 19	8.15	5.46	4.76	2.89	5.12	2.03	17.39	15.53
June 8	10.38	6.86	5.75	1.82	6.73	2.37	22.68	21.44
June 24	12.74	7.47	5.93	4.87	7.60	2.15	26.27	24.04
July 10	.....	.....	4.80	7.40	10.50	3.19	.....	.....
Average	8.47	5.35	5.51	4.11	5.51	1.90	18.08	16.88

[1] 100 plants examined.

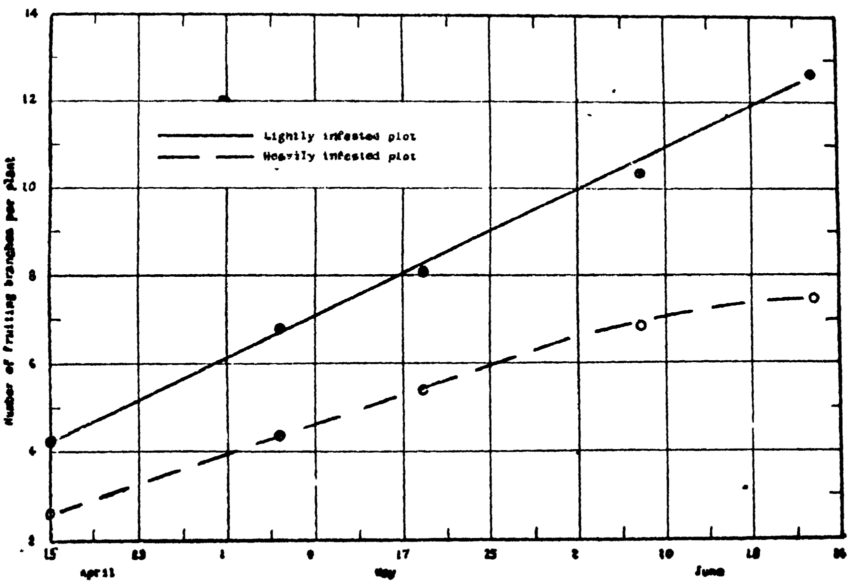

FIG. 2.—Average number of fruiting branches per plant on two plots, each plot containing 100 cotton plants with light and heavy infestation of the West Indian blister mite (*Eriophyes gossypii*) on each plot, Isabela, P. R., 1936.

Since these plots were also infested with the pink bollworm (*Pectinophora gossypiella* Saund.), the amount of seed cotton produced on each plot could not be used as a basis to estimate the damage caused by the West Indian blister mite. Therefore the best criterion was the number of bolls produced on each plot, since the pink bollworm causes but little if any shedding of the fruiting forms. As shown in figure 3, the difference in the number of bolls between the lightly and heavily infested plots also progressively increased at each consecutive bimonthly examination. The average difference per plant between the number of bolls in the lightly and heavily infested plots was 3.61 and ranged from 0.08 on April 15 to 7.31 on July 10.

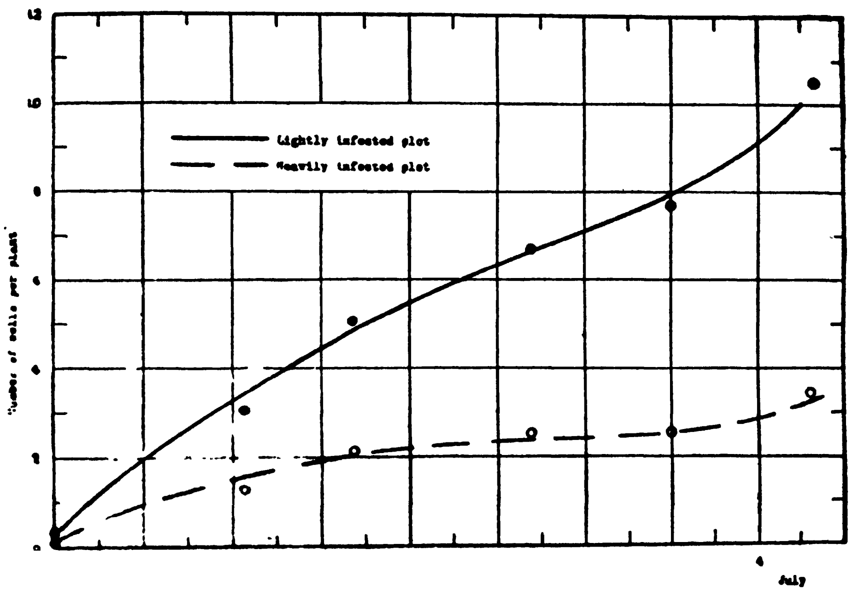

FIG. 3.—Average number of bolls per plant on two plots, each plot containing 100 cotton plants with light and heavy infestation of the West Indian blister mite (*Eriophyes gossypii*) on each plot, Isabela, P. R., 1936.

The average ratio of the number of squares on the two plots was 1 : 1.3+. The number of squares on the lightly infested plot was greater than on the heavily infested plot from April 15 to July 1, while the examination on July 10 showed the reverse to be true.

There is no doubt that the mites on the lightly infested plot caused considerable injury and consequently there was less difference in the number of fruiting branches and forms between these two

plots than would have been found if this plot had not become infested.

Carry-over and control.—So far as is known, cotton is the only host plant of the West Indian blister mite. In Puerto Rico cotton grows throughout the year and usually green plants that have not been destroyed or that have put out volunteer growth are present around the fields. Observations indicate that there is no hibernation period and that the mites continue to develop on these plants and spread to new plantings. In a field of young cotton at Isabela, on April 15, 1936, a heavy mite infestation was observed which had evidently spread from the new growth on old stalks in an adjacent field. These factors indicate that thorough cleaning of old fields and strict enforcement of a closed season when no green cotton is present would be an effective means of control. Wilson (4) has stated that a closed season of from 2 to 4 weeks is sufficient if properly enforced.

Blister mites of the genus Eriophyes on other malvaceous plants.—Blister mites of the genus *Eriophyes*[1] were found attacking two different species of malvaceous plants, namely, *Bastardia viscosa* and *Malachra capitata.* Since the blisters formed by these mites were quite similar to those made by the West Indian blister mite (*Eriophyes gossypii* Banks), it was deemed important to determine if these species were the same and would attack cultivated cotton. Twenty-four cotton plants, bearing mature green bolls, were divided into three lots containing eight plants in each. Leaves of *Bastardia viscosa* and *Malachra capitata* (*Malva*) and cotton (*Gossypium* sp.), heavily infested with mites of the genus *Eriophyes,* were fastened paper clips on the leaves of normal cotton plants. Only the transfers from cotton to cotton were successful, all the plants of this group becoming infested. This experiment was repeated with six young cotton plants, 10 inches in height, in each group. Again all the transfers from cotton to cotton were successful, and only these. These results show that the mites of the genus *Eriophyes* found on *Bastardia viscosa* and *Malachra capitata* in Puerto Rico will not attack cultivated cotton.

[1] Determined by H. E. Ewing of the Bureau of Entomology and Plant Quarantine.

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NEW OR LITTLE-KNOWN SPECIES OF WEST INDIAN TIPULIDAE (DIPTERA). II.

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The first part under this general title was published in the JOURNAL OF THE DEPARTMENT OF AGRICULTURE OF PUERTO RICO, vol. XX, No. 4, October, 1936, pages 877–882. In the present instalment, I wish to describe some interesting material collected in Puerto Rico by Messrs. Julio García-Díaz, James G. Needham and Mortimer D. Leonard, and a second rich series taken in Oriente, Cuba, by Messrs. Julián Acuña, Lawrence C. Bruner and L. Scaramuzza. The types of all the novelties are preserved in my collection of crane-flies through the friendly interest of the various collectors.

Dolichopeza (Megistomastix) acutiloba sp.n.

General coloration brown, the praescutum with four paler stripes; antennae with inconspicuous pubescence that is much shorter than the scattered, unilaterally arranged verticils; macrotrichia of wing-cells abundant; abdominal segments bicolorous, the bases of the segments brown, the posterior rings yellow; subterminal segments and hypopygium dark; male hypopygium with apex of each tergal lobe terminating in an acute spine; beak of inner dististyle relatively slender.

Male.—Length 7–8 mm.; wing 6.5–7.5 mm.

Female.—Length about 9 mm.; wing about 9 mm.

Described from alcoholic specimens.

Frontal prolongation of head pale brown; palpi brown, the outer segments slightly paler. Antennae brownish black, the pedicel yellow; flagellar segments broken beyond the third, but when entire the organ must be as long as, or longer than, the entire body; flagellar segments with scattered elongate verticils, unilaterally distributed, together with a very short, inconspicuous pubescence. Head brown, the front and orbits more brightened.

Pronotum brown. Mesonotal praescutum brown, with four paler stripes that are very poorly defined against the ground; scutal lobes a little darker than the median area; scutellum and postnotum brown. Pleura obscure yellow, indistinctly variegated with darker, especially on the anepisternum and ventral sternopleurite. Halteres dusky, the knobs whitened. Legs with the coxae brown; trochanters yellow; remainder of legs brown. Wings brownish gray; stigma oval, darker brown; veins brown. Macrotrichia of cells abundant, involving the outer ends of cells *R*, *M*, *Cu* and *1st A*, besides the cells beyond the cord. Venation: Petiole of cell M_1 a little shorter than *m*. The allotype female has cell M_1 very short-petiolate to nearly sessile.

Abdominal segments bicolorous, the bases brown, the posterior rings broadly yellow, the amount of the latter decreasing on the outer segments; outermost segments and hypopygium uniformly darkened. Male hypopygium (Fig. 6) with each lateral lobe of the tergite, *9t*, produced into an acute darkened spine; median area of tergite moderately produced. Outer dististyle, *od*, shallowly and unequally bifid, with a flattened glabrous lobule at base. Inner dististyle, *id*, with apical beak slender, pale.

Habitat.—Puerto Rico.

Holotype, ♂, El Yunque trail, Km. 1.3, June 11, 1935 (García-Díaz); Collector's No. 1200. Allotype, ♀, Picnic Grounds, Luquillo Mountains, June 7, 1935 (García-Díaz); No. 1082. Paratopotypes, 2 ♂♂, with the type, No. 1158, June 10, 1935; No. 1787, same date; paratype, 1 ♀, Luquillo Mountains, No. 46, June 10, 1935 (García-Díaz); No. 1182.

Dolichopeza (*Megistomastix*) *acutiloba* is most nearly related to *D.* (*M.*) *obtusiloba* sp.n., in the short, inconspicuous pubescence of the male antennae. The two species are most readily told from one another by the structure of the male hypopygium, especially the lateral lobes of the ninth tergite. The paratype female (No. 1182) has the petiole of cell M_1 unusually long, considerably exceeding *m*, and with a distinct darkened cloud on the anterior cord. It may pertain to a different species.

Dolichopeza (Megistomastix) obtusiloba sp.n.

Male.—Length about 7.5 mm.,; wing 8 mm.

Described from alcoholic specimens.

Characters very similar to those of *acutiloba* sp. n., differing especially in the structure of the male hypopygium. Pubescence of flagellar segments pale, a trifle longer and more erect than in *acutiloba* but still less than a fifth as long as the conspicuous erect black verticils. Thoracic pattern much as in *acutiloba*. Wings with unusually abundant macrotrichia, which include nearly the outer two-thirds of cell *R* and the outer end of cell *2nd A*, as well as being very abundant in all outer cells. Venation: Union of R_1 and R_2 angulated and, in cases, with a spur of R_{1+2} persisting beyond the point of their union. Abdomen bicolorous, as in *acutiloba*, the pattern persisting to the outer segments; hypopygium pale. Male hypopygium (Fig. 7) with the lateral arms of tergite, *9t*, relatively long and conspicuous, at ends a little expanded into a head and provided with blackened spinous setae; median area of tergite strongly produced. Outer dististyle, *od*, deeply bifid, the inner arm very strongly capitate and set with abundant short dark setae; outer arm clavate, clothed with much longer setae. Inner dististyle, *id*, with the apical beak very stout; lobe at its base darkened.

Habitat.—Puerto Rico.

Holotype, ♂, El Yunque trail, Km. 1.3, July 27, 1935 (García-

Díaz); Collector's No. 1477. Paratopotypes, 1 ♂, Luquillo Mountains, west of swimming pool, November 18, 1935 (Needham & García-Díaz); No. 25; 1 ♂, Trout's Creek No. 1, Luquillo Mountains, June 9, 1935 (García-Díaz), No. 1122.

Dolichopeza (Megistomastix) vittinervis sp.n.

Antennae black throughout; mesonotal praescutum dark brown, with three grayish stripes, the broad median vitta vaguely divided by a dusky median line; pleura brownish gray, variegated with obscure yellow on the dorsal sternopleurite, ventral pteropleurite and meral region; knobs of halteres weakly infuscated; wings tinged with dusky; cells *C* and *Sc* brown, cord and veins *Cu* and *2nd A* seamed with brown; abundant, dark-colored macrotrichia in cells R_1 to M_4, inclusive, not reaching the cord of wing and not including cells *Cu* or *1st A*; *m* subequal to the petiole of cell M_1.

Female.—Length about 7.5 mm.; wing 8 mm.

Frontal prolongation of head dark grayish brown; palpi brownish black. Antennae black, only the pedicel a very little paler; basal flagellar segments of moderate length, with very short, delicate setulae and scattered longer verticils; outer segments shorter. Head brownish gray.

Mesonotal praescutum with the ground-color dark brown, with three grayish stripes, the median one broad, vaguely divided by a dusky median line; scutum with median area clear gray, the lobes more infuscated; scutellum and mediotergite clearer gray. Pleura chiefly brownish gray, variegated by an obscure yellow on the dorsal sternopleurite, pteropleurite and meral region but not forming a distinct longitudinal stripe; dorsopleural membrane light brown. Halteres pale, the knobs weakly infuscated. Legs with the coxae brownish gray; trochanters yellow; femora obscure brownish yellow, the tips narrowly darker; tibiae and tarsi infuscated. Wings (Fig. 1) with a strong dusky tinge, cells *C* and *Sc* brown; stigma and relatively conspicuous seams on anterior cord, posterior cord, and veins *Cu* and *2nd A* darker brown; veins and macrotrichia dark brown, conspicuous. Macrotrichia abundant in cells R_1 (stigma), R_2, R_3, R_5, M_1, *2nd* M_2, M_3, and M_4, not attaining the bases of the cells and not crossing basad of cord (position of trichia shown in figure by stippled dots); no trichia in cells *Cu* or *1st A*. Venation: R_{1+2} represented only by a tiny spur; *m* arcuated at near midlength, subequal to the petiole of cell M_1; M_{3+4} short, with *m-cu* at its fork.

Abdomen badly discolored by eggs within body; tergites chiefly light brown; cerci appearing as strongly compressed blades, their tips obtuse; hypovalvae very reduced.

Habitat.—Cuba (Oriente).

Holotype, ♀, Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner and Scaramuzza).

Dolichopeza (*Megistomastix*) *vittinervis* is quite distinct from the other species of the subgenus so far made known. It is apparently closer to the Puerto Rican species than it is to *D.* (*M.*) *cubensis* (Alexander) of western Cuba. The darkened antennae, pattern of

praescutum and wings, and the restriction of the very conspicuous wing-trichia provide good characters for the separation of the species.

Limonia (Rhipidia) tetraleuca sp.n.

General coloration yellow, variegated by brown; antennae brown, with four subterminal segments white; knobs of halteres variegated with white; posterior tarsi with three subterminal segments light yellow; wings cream-colored, the posterior cells darker; a relatively heavy darker brown costal pattern, the areas at origin of *Rs* and fork of *Sc* disconnected; wing-tip and axilla pale; basal abdominal segments whitened, the succeeding tergites with a brown median vitta.

Female.—Length about 7.5 mm.; wing 6.7 mm.

Described from the alcoholic type.

Rostrum black, the labial palpi paler; maxillary palpi black throughout. Antennae black, with segments ten to thirteen, inclusive, abruptly white; pedicels of the intermediate flagellar segments a little paler than those of the more basal ones; flagellar segments moderately produced, with conspicuous glabrous apical pedicels that become more elongate and slender on outer segments; terminal segment nearly as long as the preceding two taken together, its distal third narrowed. Head dark brown.

Pronotum dark medially, paler on sides. Mesonotal praescutum with an irregular dark pattern, the median stripe broad and entire on posterior half, interrupted and reduced to a capillary median vitta on anterior half, at cephalic border continuous with a narrowly darkened border; the latter area at its outer end has a sinuous broken stripe extending backward to the suture, roughly paralleling the median vitta, as described; scutum pale medially, the inner margin of each lobe entirely traversed by a dark brown stripe that extends to the chiefly darkened scutellum; mediotergite dark brown, with a conspicuous pale spot at each antero-lateral portion. Pleura chiefly pale, traversed by two longitudinal brown stripes, the more dorsal one much wider, extending from the propleura to beneath the abdomen. Halteres variegated, the base of stem yellow, the distal half black; knob black, extensively variegated with whitish. Legs with the coxae chiefly pale, traversed by the ventral pleural stripe; trochanters pale; remainder of legs dark brown, the posterior tarsi with segments two to four, inclusive, entirely light yellow. Wings with the cephalic half cream-colored, the posterior portion more darkened; anterior border variegated by about six large darker areas, the fourth (origin of *Rs*) and fifth (fork of *Sc*) disconnected; a narrow subterminal darkened fascia; wing-tip, in cells R_2 to *2nd* M_2, inclusive, pale; cord and outer end of cell *1st* M_2 narrowly darkened; axilla, in both anal cells, conspicuously white; veins brown, *Cu* yellow. Venation: Sc_1 ending shortly beyond midlength of *Rs*, Sc_2 at its tip; cell *1st* M_2 relatively long, its inner end strongly arcuated, with *m-cu* at fork of *M*.

Abdomen with the first segment and base of the second pale, the remaining tergites conspicuously darkened medially, narrowly pale on sides; darkened area narrowed behind, the pale borders correspondingly widened; sternites yellow. Ovipositor with the cerci small and weak, darkened, not extending caudad beyond the tips of the hypovalvae.

Habitat.—Puerto Rico.

Holotype, ♀, El Yunque trail, Km. 1.3, July 7, 1935 (García-Díaz); Collector's No. 1419–43–35.

The present fly is most nearly allied to *Limonia* (*Rhipidia*) *subcostalis* Alexander (Central America), differing especially in the pattern of the thoracic dorsum, abdomen and antennae. I had earlier (Dept. Sci. & Agr. Jamaica, Ent. Bull. 4 : 21–22; 1929) reported *subcostalis* from Jamaica, but it now appears more probable that the latter material represents a still different species. It is unfortunate that the males of several of these forms are still unknown.

Shannonomyia scaramuzzai sp.n.

General coloration dark brown, the pronotum and lateral pretergites ashy-gray; legs brownish yellow, the terminal tarsal segments darker; wings almost uniformly tinged with gray, the stigma pale brown; R_3 oblique, nearly twice R_{1+2}; R_2 subequal to R_{2+3}; cell *1st* M_2 closed; abdomen dark brown; hypopygium obscure brownish yellow.

Male.—Length about 4–4.2 mm.; wing 3.8–4 mm.

Female.—Length about 5.5–6 mm.; wing 4.5–4.8 mm.

Rostrum and palpi black. Antennae brown to dark brown, the scape more or less pruinose; flagellar segments subglobular to short-oval, the outer ones a trifle longer; verticils about twice the length of the segments. Head dark grayish brown.

Pronotum light ashy-gray, the coloration continued caudad on the lateral pretergites to the wing-root. Mesonotum uniformly dark brown, the praescutum unstriped. Pleura dark brown, sparsely pruinose. Halteres pale to slightly dusky, the knobs slightly more infuscated. Legs with the coxae and trochanters obscure yellow; remainder of legs brownish yellow, the terminal tarsal segments darker. Wings (Fig. 2) almost uniformly tinged with gray; stigma oval, pale brown, bisected by R_2; veins pale brown. Macrotrichia of veins very variable, in cases with numerous trichia on veins beyond cord, including a series of about a dozen on R_3, in other specimens R_{2+3+4}, R_{3+4} and R_3 without trichia. Venation: Sc_1 ending opposite midlength of *Rs*, Sc_2 at its tip; *Rs* angulated to weak-spurred at origin; R_2 subequal to R_{3+4}; R_3 oblique, nearly twice R_{1+2}; cell *1st* M_2 closed, exceeding in length vein M_4 beyond it; *m-cu* about two-thirds its length beyond fork of *M*.

Abdomen dark brown; hypopygium obscure brownish yellow.

Habitat.—Cuba (Oriente).

Holotype, ♀, Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner and Scaramuzza). Allotopotype, ♀. Paratopotypes, 1 ♂, 1 ♀; paratypes, several of both sexes, Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936, at light (Acuña).

I take much pleasure in naming this fly in honor of Mr. L. Scaramuzza, who collected part of the type series. The fly is amply

distinct from the other Antillean species so far made known. It differs from *brevicula* Alexander and *mesophragma* Alexander, in the venation and in the virtually unmarked wings. In the latter regard it comes closer to *triangularis* Alexander, of Puerto Rico, which has cell M_2 of the wings open.

Gnophomyia (Gnophomyia) diazi sp.n.

Size small (wing, ♀, 4.7 mm.); general coloration black, including antennae, halteres and legs; wings nearly hyaline, with conspicuous black veins; R_{2+3+4} very strongly arcuated, nearly erect; cerci with setae to extreme tips.

Female.—Length about 5 mm.; wing 4.7 mm.

Described from the alcoholic type.

Head and appendages black; flagellar segments of antennae oval, the verticils subequal in length to the segments.

Thorax and appendages black. Wings (Fig. 3) nearly hyaline; stigma faintly indicated as a cloud beyond R_2; veins black, conspicuous. Venation: R_{2+3+4} very strongly arcuated, nearly erect; R_2 subequal to R_{3+4}; R_5 close to R_{1+2}, slightly upcurved at its tip; cell R_3 at margin wider than cell R_2; cell *1st* M_2 narrowed at proximal end; *m-cu* about one-third its length before fork of M.

Abdomen black; terminal segments narrowed, but not as markedly so as in *arcuata;* cerci with the tips truncated, provided with setae to extreme ends.

Habitat.—Puerto Rico.

Holotype, ♀, Luquillo Mountains, Km. 11.8, Lot 46, June 7, 1935, at light (García-Díaz); Collector's No. 1028–38–35.

I take unusual pleasure in dedicating this species in honor of the collector of the rich series of Puerto Rican Tipulidae discussed in this report. The only related species so far described is the larger *Gnophomyia arcuata* Alexander (British Guiana), which, besides its major size, differs in the more produced cerci and genital segment, and in slight details of venation and trichiation of the veins. The discovery of a species of *Gnophomyia* in the Greater Antilles is of unusual interest.

Gonomyia (Lipophleps) monacantha sp.n.

Male.—Length about 4–4.5 mm.; wing 3.2–4 mm.

Female.—Length about 5.5–6 mm.; wing 4–4.5 mm.

Belongs to the *cinerea* group; closely allied to *helophila* Alexander, differing chiefly in the structure of the male hypopygium, notably of the outer dististyle.

The fly has been adequately described and figured under the name *helophila* Alexander (Journ. Dept. Agr. Puerto Rico, 16 : 373, fig.

20; 1932), with which species it has been long confused in collections. The receipt of rather numerous specimens from Señor García-Díaz indicates that the Puerto Rican fly is distinct from *helophila*, which has a vast range on the American mainland, from Texas as far south as Peru. The structure of the male hypopygium of the two flies is shown by the accompanying figures. *G.* (*L.*) *monacantha* (Fig. 8) has a single powerful blackened spine on the inner margin of the outer dististyle. *G.* (*L.*) *helophila* (Fig. 9) has two such spines, both provided with microscopic spinulae.

The various figures of the male hypopygium of *helophila* hitherto provided (Ent. News, 27 : 345, fig. 3; 1916. Proc. Acad. Nat. Sci. Philadelphia for 1916, pl. 29, fig. 60; 1916) are inaccurate as regards the nature of the lobe of the outer dististyle.

Habitat.—Puerto Rico.

Holotype, ♂, Vieques Island, at light, September 25–27, 1931 (Leonard). Paratypes, 10 alcoholic ♂ ♀, Yúñez River, June 19, 1935, at light (García-Díaz); Nos. 1279, 1316; 1 ♀, Yúñez River, June 22, 1935, No. 1367; 1 ♀, Río Blanco, at light, March 6, 1935 (Needham & García-Díaz), No. 1784; 1 ♀, Lares, March 22, 1935 (Needham & García-Díaz), No. 722.

Gonomyia (Lipophleps) orthomera sp.n.

Belongs to the *manca* group; coloration yellow, the thorax variegated by brown; pleura weakly striped; male hypopygium with the dististyles terminal in position, the outer a long, slender, nearly straight spine, gradually narrowed to the acute tip; phallosome a single median structure, entirely pale, in slide mounts extending caudad to beyond the tip of the longest dististyle.

Male.—Length about 3.8–4 mm.; wing 2.8–3 mm.

Female.—Length about 4.5 mm.; wing 3.5 mm.

Described from alcoholic specimens.

Rostrum yellow; palpi dark brown. Antennae brownish black throughout, the flagellar segments with elongate verticils in both sexes, longer in the male. Head yellow, the center of vertex weakly darkened.

Pronotum yellow. Mesonotum yellow, the praescutum chiefly covered by three confluent brown stripes; median area of scutum yellow, the lobes brown; scutellum yellow; mediotergite yellow on sides, the central portion more darkened. Pleura yellow, with vague and poorly defined brown longitudinal stripes, the more dorsal occupying the propleura, anepisternum and ventral meron, becoming obsolete before the root of halteres. Halteres pale brown, the knobs whitened. Legs with the coxae pale brown; trochanters yellow; remainder of legs brown. Wings strongly tinged with brown, the stigma scarcely darker; veins pale. Venation: Sc_1 ending a distance before origin of *Rs* nearly equal to the length of the latter; branches of *Rs* strongly divergent near outer ends; *m-cu* before fork of *M*.

Abdominal tergites pale brown; sternites more yellowish; hypopygium yellow. Male hypopygium (Fig. 10) with the dististyles terminal in position; outer style, *od*, a long, nearly straight, simple spine that narrows to an acute point, the distal third darkened; inner style about one-half the length of the outer, weakly constricted near midlength. Phallosome, *p*, entirely pale, consisting of a long median structure, gradually narrowed outwardly, the apex slightly exceeding the tips of the longest dististyle.

Habitat.—Puerto Rico.

Holotype, ♂, Tanamá River, March 12, 1935, at light (Needham & García-Díaz), No. 545–21. Allotopotype, ♀. Paratopotypes, 2 ♀♀; 1 broken ♂, May 11, 1935 (García-Díaz), No. 882–21. Paratypes, 1 ♂, 1 ♀, Río Cidra, March 23, 1935 (Needham & García-Díaz), No. 819.

Gonomyia (*Lipophleps*) *orthomera* is entirely distinct from all previously described Neotropical members of the subgenus. By my key to the Puerto Rican species of *Lipophleps* (Journ. Dept. Agr. Puerto Rico, 16 : 371; 1932), the species runs to couplet 3, being very distinct from *bifiligera* Alexander, the male hypopygium of which has a single, entirely fleshy dististyle.

Toxorhina (Toxorhina) domingensis sp.n.

Mesonotum light ashy-gray, the praescutum with three brown stripes, the median one darker than the laterals; rostrum about four-fifths the length of wing; wings pale gray, the prearcular area pale yellow; veins pale brown, relatively distinct against the ground-color; male hypopygium with a slender darkened spine on mesal face of basistyle near tip; dististyle with the outer lobe roughly quadrate in outline; aedeagus lyriform, each arm relatively long, sinuous, drawn out into hair-like points.

Male.—Length, excluding rostrum, about 5.5 mm.; wing 5.2 mm.; rostrum alone 4.2 mm.

Rostrum about four-fifths as long as wing, pale brown, darker at outer end. Antennae with scape and pedicel dark brown; flagellum broken. Head brownish gray.

Mesonotal praescutum light ashy-gray, with three brown stripes, the median one darker and more clearly delimited; scutal lobes infuscated, the median area light gray; scutellum darkened basally, the posterior border pale; mediotergite brownish gray, paler laterally. Pleura light reddish brown, sparsely pruinose, with indications of darker longitudinal stripes, especially on the ventral sternopleurite. Halteres pale yellow, the knobs, excepting the tips, weakly infumed. Legs with the coxae light brown, paler at tips; trochanters yellow; remainder of legs pale brown, the tips of tibiae and the outer tarsal segments slightly darker. Wings (Fig. 4) with a pale gray tinge, the prearcular area pale yellow; veins pale brown, relatively distinct against the ground. Venation: Sc_1 ending opposite origin of *Rs*; R_1 very short, extending beyond the origin of *Rs* to a distance about equal to *r-m*; outer end of cell *1st* M_2 narrowed; *m* short, less than one-half *r-m*; *m-cu* about one-third its length before the fork of *M*.

Abdomen, including hypopygium, chiefly dark brown. Male hypopygium (Fig. 11) with the basistyle bearing a slender darkened spine on inner face near tip. Dististyle, *d*, with the outer lobe extensive, roughly quadrate in outline, the margin blackened, the inner or distal angle slightly more produced than the outer or more basal one. Arms of ædeagus *a*, elongate, each strongly sinuous to produce a lyriform appearance, their tips narrowed into hair-like points.

Habitat.—Santo Domingo.

Holotype, ♂, Sánchez, June 13–18, 1915. Paratopotype, Sex?, San Lorenzo, June 24–26, 1915.

In the structure of the male hypopygium the present fly is closeest to *Toxorhina* (*Toxorhina*) *mendosa* Alexander (southern Brazil), differing in the details of venation and coloration, and in the structure of the hypopygium, especially of the aedeagus. The species that I have now determined as being *T.* (*T.*) *fragilis* Loew, with which the present fly was formerly confused in my collection Del., has a very distinct hypopygium, with the basistyle unarmed and the dististyle and aedeagus entirely different in structure.

Toxorhina (Toxorhina) violaceipennis sp.n.

Mesothorax deep orange; rostrum, legs and abdomen black; head gray; wings nearly hyaline, the membrane with unusually strong violaceous reflexions; veins black; *r-m* at near midlength of cell *1st* M_2.

Male.—Length, excluding rostrum, about 8 mm.; wing 7 mm.

Female.—Length, excluding rostrum, about 7.5–9 mm.; wing 5.3–7 mm.; rostrum about 3.8–4 mm.

Rostrum black, approximately one-half the length of remainder of body. Antennae black throughout; scape short. Head gray; anterior vertex relatively wide, a little less than three times the diameter of the pedicel.

Pronotum brownish black. Mesonotum deep orange, the praescutum weakly tinged with brown but without evident stripes. Pleura orange. Halteres brownish black. Legs with the fore coxae darkened, the remaining coxae and trochanters pale; remainder of legs black. Wings (Fig. 5) nearly hyaline, the membrane with unusually strong violaceous reflexions; veins black, very conspicuous against the ground. Venation: Sc_1 ending opposite origin of *Rs*, Sc_2 a little removed from tip; *r-m* at near midlength of cell *1st* M_2, the first and second sections of vein M_{1+2} subequal; cell *1st* M_2 closed; *m-cu* variable in position, from about one-fourth its length before the fork of *M* to this same distance beyond the fork; cell *2nd A* relatively wide.

Abdomen, including genital shield and valves of ovipositor, black. Male hypopygium black; mesal face of basistyle near apex with very abundant blackened setulose spines; apex of basistyle produced into a slender horn or spike. Dististyle blackened, produced into a slender apical beak and with a high outer crest, the entire outer margin microscopically roughened or serrulate. Branches of aedeagus short. Ninth tergite profoundly split along the midline and provided with an extensive triangular area that is densely set with very small, blackened setae and points.

Habitat.—Cuba (Oriente).

Holotype, ♂, Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza). Allotype, ♀, Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Paratypes, 2 ♀♀, with the allotype.

Toxorhina (*Toxorhina*) *violaceipennis* is very different from all other described species in the Neotropical fauna, the orange mesothorax contrasting markedly with the black rostrum, legs, wing-veins and abdomen.

EXPLANATION OF FIGURES.

(Symbols: Male hypopygium,—*a,* aedeagus; *b,* basistyle; *d,* dististyle; *id,* inner dististyle; *md,* intermediate dististyle; *od,* outer dististyle; *p,* phallosome).

Figure 1. *Dolichopeza (Megistomastix) vittinervis* sp.n., venation.

Figure 2. *Shannonomyia scaramuzzai* sp.n., venation.

Figure 3. *Gnophomyia (Gnophomyia) diazi* sp.n., venation.

Figure 4. *Toxorhina (Toxorhina) domingensis* sp.n., venation.

Figure 5. *Toxorhina (Toxorhina) violaceipennis* sp.n., venation.

Figure 6. *Dolichopeza (Megistomastix) acutiloba* sp.n., male hypopygium.

Figure 7.—*Dolichopeza (Megistomastix) obtusiloba* sp.n., male hypopygium.

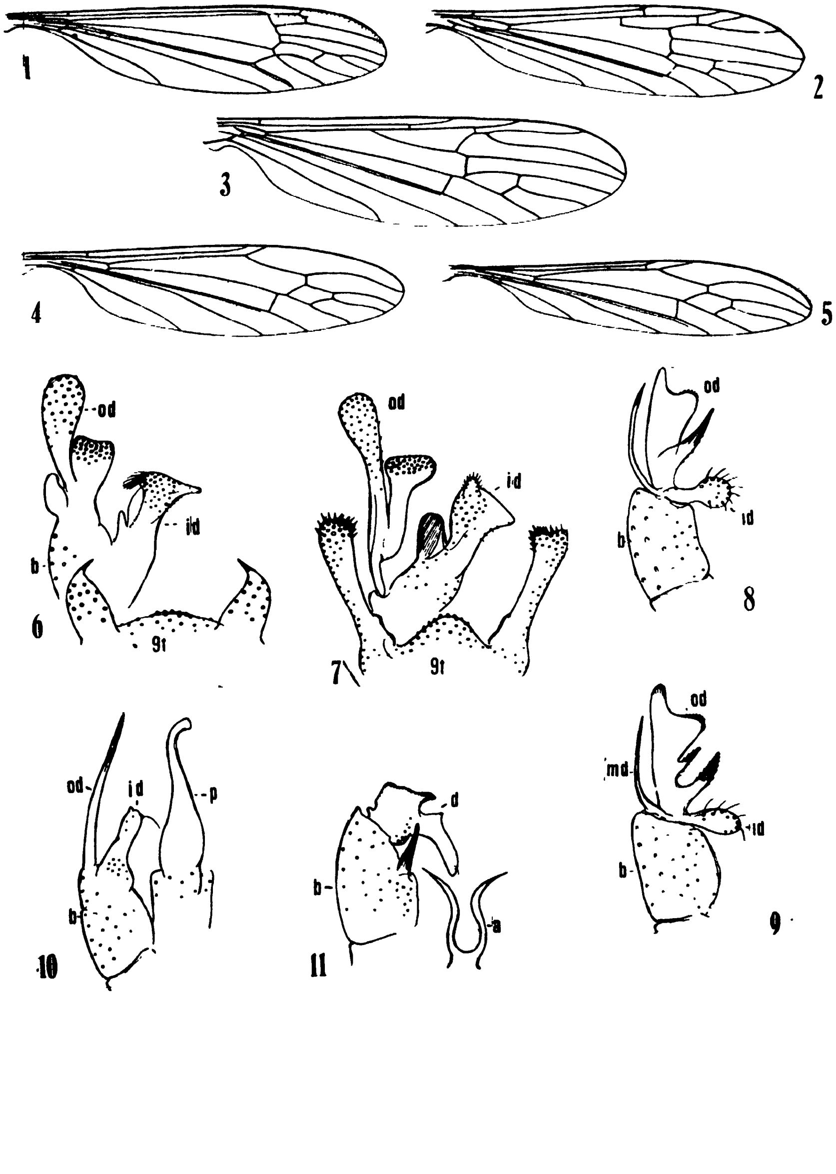
Figure 8. *Gonomyia (Lipophleps) monacantha* sp.n., male hypopygium.

Figure 9. *Gonomyia (Lipophleps) helophila* Alexander, male hypopygium.

Figure 10. *Gonomyia (Lipophleps) orthomera* sp.n., male hypopygium.

Figure 11. *Toxorhina (Toxorhina) domingensis* sp.n., male hypopygium.

PLATE VIII



STUDIES IN THE ENTOMOPHTHORACEAE

I. Observations on the genus *Conidiobolus*[1]

ARTHUR G. KEVORKIAN[2]

INTRODUCTION

While in Cuba during the summer of 1933 the writer encountered a fungus growing on living termites which had been placed in damp chambers for observation. Upon examination, the fungus proved to be a species of *Conidiobolus,* one of the Entomophthoraceae. This circumstance immediately aroused the writer's interest, since, so far as can be ascertained from the literature, no members of this genus have been reported as infesting termites. The fungus is of further interest since it was found to be identical with a saprophytic species described by Martin (6) as *Conidiobolus villosus,* which appeared as a contaminant on a plate of nutrient agar containing a bit of decaying wood harbouring a species of *Hypochnus.* Moreover, since the genus *Conidiobolus* is separated from *Empusa* and *Entomophthora,* among other reasons because of its saprophytic mode of existence, the writer was led to make further studies of the nature and affinities of the fungus in question in the hope that a comparison with other species of the Entomophthoraceae might help to elucidate the relationships of the various genera within the family. At the same time it was hoped to gain some understanding of the biology of the species concerned and to ascertain by experiment its ability to infect living insects, as well as to grow on various substrata.

MATERIALS AND METHODS

The Cuban fungus was isolated directly from termites of the genus *Nasutitermes*[3] inhabiting aerial termitaria by allowing spores

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[1] Contribution from the Laboratories of Cryptogamic Botany, Harvard University, No. 148, and No. 10 from the Department of Botany and Plant Pathology, University of Puerto Rico, College of Agriculture.

[2] This investigation was undertaken while the writer was the holder of an Edwin F. Atkins Scholarship, stationed at the Harvard Botanical Gardens at Cienfuegos (Soledad), Cuba.

[3] The writer has recently collected from termites of the same genus in Cabo Rojo and Mayagüez, Puerto Rico, material which, when cultured, was found to have a life history similar to that of the Cuban fungus, although the former possesses slightly smaller spores (average diameter of smooth type 28–34 u). This is the first report of the occurrence of this fungus from the island.

from conidiophores on infected insects to be discharged against the lid of damp chambers and by transferring these spores to Blakeslee's agar. Subcultures of Martin's[2] type material of *Conidiobolus villosus* and an undetermined culture of *Conidiobolus,* isolated by Derx, from an unknown origin, as well as an unnamed species of Empusa described by Sawyer (10) were grown under similar conditions for comparison.

For the purpose of studying the life-cycle of these fungi, van Tieghem cells were for the most part employed; petri dishes proved most useful in studying the growth of the fungi on different media. Furthermore, in order to ascertain whether the fungi were truly saprophytic or facultative parasites, inoculation experiments were conducted. Petri dishes of the fungi were first allowed to grow luxuriantly and to sporulate abundantly, and then the insects were allowed to crawl over the surface of the cultures for varying periods of time, at the end of which the insects were removed to sterile petri dishes containing paper moistened in order to maintain and insure optimum conditions of humidity for the development of these fungi.

Observations

Since the Cuban strain, unlike the other members of the genus, was found to be parasitic on termites, it first became necessary to establish its identity by working out its morphology, development and life-cycle in pure culture. When placed on artificial media, the subspherical, to ovoid basally apiculate spore, sends out from any point on the periphery except the rounded apiculus, a short germ tube which may bear a secondary conidium (fig. 2, I) similar to the first but slightly smaller, or may elongate, branch, and produce extensive hyphae which later, by the appearance of cross-walls, form irregularly shaped hyphal bodies. Within the host, however, the mycelium very soon begins to break up into hyphal bodies which subsequently give rise to mycelia that penetrate the insect body and emerge as external conidiophores which later bear the smooth or primary conidia (fig. 1, E-F). These are discharged in a manner similar to that described by Martin (6) for *Conidiobolus villosus* and by Thaxter (12) for *Empusa* (*Triplosporium*) *Fresenii.* Some of the primary conidia may then produce capillary or villose outgrowths (fig. 1, G-H), usually densely covering the entire surface of the

[2] Martin's type strain from the Thaxter culture collection at the Farlow Herbarium; Derx strain from the Centraalbureau voor Schimmelcultures in Holland; Cuban strain from Harvard Botanical Gardens, Cienfuegos, Cuba; and *Empusa* sp. from Miss O. M. Jacobs of Hunter College, New York City.

spore as in *Delacroixia coronata*, Gallaud (4), fig. 1, E, or occasionally restricted to small areas of the spore surface (fig. 2, A) thus approaching *Empusa* (*Triplosporium*) *Fresenii* (Thaxter l. c.), *Entomopthora fumosa* Speare (**11**), and *Entomophthora pseudococci* Speare (**11**). Under favorable conditions, that is with an abundance of moisture, nutriment and warmth (70–75° F), the hair-like appendages may swell at their terminal extremities (fig. 2, C) and give rise to minute uninucleate piriform or subglobose conidia (fig. 2, D-G) within 36–48 hours after the villose spores have been discharged from the conidiophores.

The life-history and morphology of this Cuban fungus, as just described, show certain similarities to those of another member of the Entomophthoraceae namely, *Delacroixia coronata* (Cost.) Sacc. and Syd., agreeing not only in the size and shape of the conidia but also in the production of villose spores which in turn may bear minute conidia at the ends of the capillary projections. The fungus agrees also with *Conidiobolus villosus* except that, in Martin's (**6**) original description no mention was made of the small conidia. It should be noted, however, that Martin's description gives an excessive range of size for the conidia including some so small as to suggest that the latter had originated, unobserved, as micro-conidia. Furthermore, while studying the type culture of *C. villosus*, the writer was able to obtain micro-conidia under the conditions mentioned above. Martin (l. c., p. 314) states that "A few resting spores have been seen in which the hairs were slightly swollen at the tips. In one culture a very few of the resting spores were provided with distinctly conical, spine-like processes. Intermediate stages were present in all cases, and such aberrant spores seem to represent minor variations due to unknown causes." Had the spores been examined in a saturated atmosphere, it seems probable that the significance of the variations might have been evident, and that these aberrant spores would have been found to be proliferating into micro-conidia, the "conical, spine-like processes" representing the former point of attachment of these minute spores. Under unfavorable moisture conditions, that is, absence of water of condensation, the echinate conidia or "resting spores" become thick-walled and after a period of rest when transferred to a suitable substratum, do not produce the micro-conidia, but germinate by putting forth a germ tube similar to that described by Martin (l. c.)

Like Martin (**6**) and Gallaud (**4**), the writer was unsuccessful in all his attempts to secure the sexual phase of the fungus, even by contrasting the various strains in artificial culture. However the

appearance in the Cuban material of certain thick-walled structures closely resembling zygospores, needs further critical study to determine their true nature.

The presence of micro-conidia in *Conidiobolus villosus* not only indicates a general relationship of this fungus with members of Thaxter's (**12**) sub-genus *Triplosporium,* of *Empusa,* but also brings into question the status of the species. In 1897 Constantin (**3**) described *Boudierella coronata,* a fungus which he had isolated from the gills of *Psalliota campestris,* as a new genus of the Entomophthoraceae. This fungus, which is known only in the conidial stage, is characterized not only by the formation of villose conidia or "resting spores", but also by the production of micro-conidia as noted above. Later Saccardo and Sydow renamed the fungus *Delacroixia coronata* (Cost.) Sacc. and Sydow, since the former generic name had been preëmpted. In 1905 Gallaud (**4**) isolated the same fungus from orchid seeds, but since he only rarely obtained the "spores en couronne" of Costantin, he referred the material to the original author for identification.

Since *Delacroixia coronata* and *Conidiobolus villosus* are so similar in their life histories and morphological details, the writer feels that there is no necessity of maintainng the two names unless it is possible eventually to demonstrate differences in the sexual phases of the two genera. Furthermore since the genus *Delacroixia* was based only on the appearance of "spores en couronne" or micro-conidia, induced by an abundance of moisture as in *C. villosus,* the writer agrees with Lakon (**5**) that this is not a sound basis for establishing a new genus, since Thaxter (l. c.) had already shown that a somewhat similar proliferation takes place in the sub-genus *Triplosporium* of the genus *Empusa.*

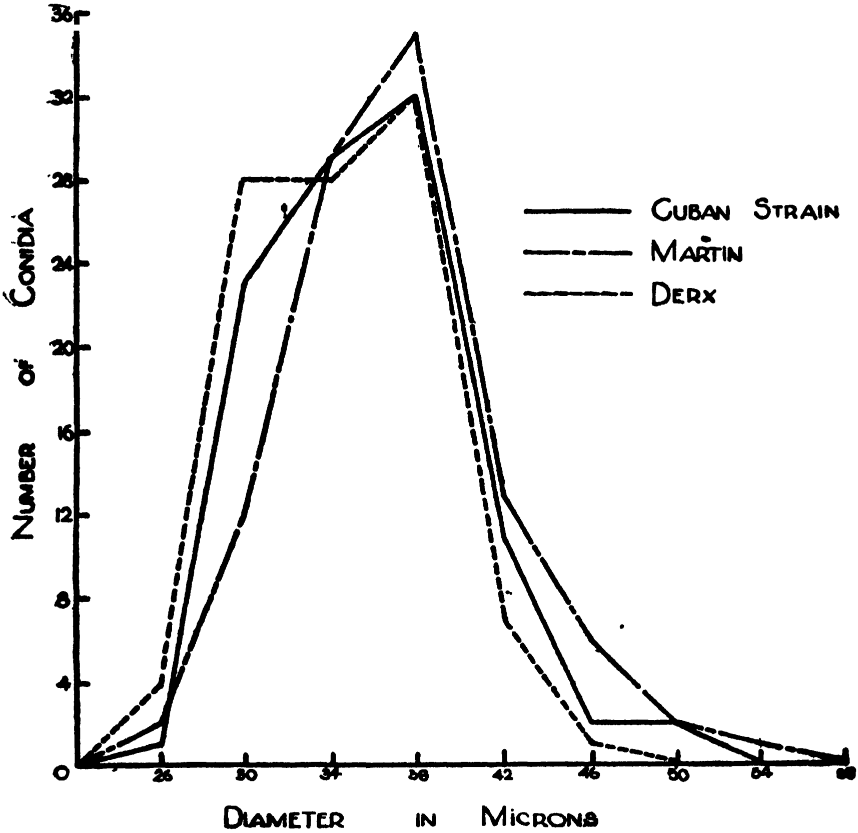
In view of the fact that *Conidiobolus* has been separated from *Entomophthora* and *Empusa,* primarily because of its saprophytic mode of life, experiments were undertaken to test the ability of the three strains of *C. villosus* to parasitize various insects. The writer, therefore, in triplicate series, exposed thirty-five termites and ten corn-borer larvae to infection by allowing them to crawl about on three sets of petri-dish cultures representing the three strains of the fungus that have been discussed above, and then placed the insects in damp chambers. This experiment showed that not only the Cuban strain isolated from termites but also the type material of *C. villosus* originally from rotten wood, was able to infect 60% of the termites within ten days, whereas in the case of the Derx strain whose source of isolation is not known, no infection took place

even at the end of twenty-one days. These results immediately suggested that there was a physiological difference which distinguished the latter strain from the other two. In contrast, only one corn-borer was killed by the Cuban strain after ten days, while the others remained free from infection even after a longer period of exposure. In a similar experiment however *Empusa* sp., attacked approximately 40% of the larvae within the same length of time and under similar environmental conditions. The present experiments with the Cuban fungus on termites, together with the earlier work of Costantin (**3**) who was successful in infecting *Musca domestica* with his organism, demonstrates the fact that these reputedly. saprophytic fungi may live parasitically upon the proper hosts. Gallaud (**4**), however, using a variety of insects, was unable to find any evidence of parasitism, although when he placed dead cockroaches (Blatta) in contact with the spores he found that infection took place most readily in the muscles of the abdomen, thorax, and appendages.

Because the Derx culture behaved so differently from the other two in regard to parasitism it became necessary to study the morphological and physiological aspects of the various strains in order to determine what differences, if any, existed among them. In order to do this, the three strains of *Conidiobolus* and *Empusa* sp. were inoculated on the following substrata: Blakeslee's agar, sterilized carrots, egg yolk, swordfish, pork and liver. After a period of ten days, growth at room temperature, the Cuban strain and the type material of *C. villosus* were practically identical on the various media used. Growth of the Derx strain on egg yolk and liver was much more vigorous than the other strains, although on the remaining substrata it was noticeably more meager. Although the growth of *Empusa,* a recognized parasite, was less abundant on Blakeslee's agar, it was comparable in vigor with the development of *Conidiobolus* on the other substrata. It seems clear from the foregoing that the so-called saprophytic *Conidiobolus* is able to parasitize termites and conversely that the parasitic *Empusa* may be grown saprophytically on a variety of artificial media. Hence the existing differences between these two genera on this basis alone loses much of its weight.

Since differences in character of growth are so slight in all but the Derx strain of *Conidiobolus,* and since the organisms lack morphological distinctions, the writer made measurements of one hundred spores of the smooth type of each of the three strains in an endeavor to find a biometrical means of distinguishing them. The spores measured were produced on the same type of media and

under identical environmental conditions. It was noted that the spores of *Conidiobolus* from the three different localities were practically indistinguishable (Graph I), although those of the type strain



were 3 u. larger than the others. In view of our present knowledge of the fungi in question, it is doubtful if the Derx strain should be considered other than as a variant. Furthermore, the aforementioned organisms agree in nuclear condition as well as in their morphological and physiological behavior. Gallaud (4) has shown that *Delacroixia coronata* possesses multinucleate conidia while Martin (6) found the same to be true in *Conidiobolus villosus*. Moreover, the writer has confirmed Martin's findings not only in the type material but in the Cuban and Derx strains as well. In the genus *Empusa* a similar multinucleate condition has been shown in the conidia of a number of species investigated by Riddle (9), Cavara (2) and Olive (8).

The fact that *Conidiobolus villosus* and *Delacroixia coronata* have been shown to be similar morphologically, cytologically, and to a lesser extent physiologically, indicates that the confusion as to their taxonomy should be clarified.

Conclusions

As has already been stated, the genus *Delacroixia* was established to include a species of Entomophthoraceae with "spores en couronne". Gallaud, in 1905 encountered a fungus with spinose resting spores which Constantin identified as his *D. coronata* deviating from the type in only rarely producing the spores typical of the genus. Later, Martin (l. c.) described *Conidiobolus villosus* characterized by the villose appendages borne on the resting spores. The present writer has shown that these appendages are capable of giving rise to minute conidia similar to those of *D. coronata* and furthermore that the two fungi are similar morphologically and physiologically. There seems, therefore, no need of maintaining the later species, *C. villosus* as distinct.

Moreover, the genus *Conidiobolus*, founded by Brefeld (**1**) in 1884 was at that time thought to be readily distinguished from *Empusa* and *Entomophthora* by its saprophytic mode of existence. This, together with the fact that the strongly branched mycelium broke up into hyphal bodies early in the life cycle of the fungus, were the criteria upon which the genus was established. It has been shown elsewhere in this paper that at least certain strains of *C. villosus* may lead a parasitic mode of life in addition to a saprophytic one.

Furthermore other investigators, such as Speare (**11**), Molliard (**7**), and Sawyer (**10**), have shown that in the genera *Empusa* and *Entomophthora* a number of species which were considered obligate parasites, in reality are able to grow saprophytically. Undoubtedly other known species will be found to have a similar facultative saprophytism if investigators interested in growing them in artificial culture observe the cultural requirements revealed by Sawyer's work. The distinction supposed to exist between *Entomophthora, Empusa* and *Conidiobolus* is, therefore, lessened; as a matter of fact, material from artificial cultures of these genera, when examined under the microscope, cannot be distinguished morphologically with any degree of certainty until the resting spores appear. In addition, the micro-conidia in Thaxter's subgenus *Triplosporium* is another structural characteristic commonly found in certain species of each of the three

genera in question. In view of these facts, the writer believes that he is justified in making the new combination **Entomophthora coronata**[1] (Cost.) with the following as synonoms: *Boudierella Coronata* Cost., *Delacroixia coronata* (Cost.) Sacc. and Syd., and *Conodiobolus villosus* Martin.

In conclusion the writer wishes to express his indebtedness to Professor W. H. Weston, Jr., under whose direction this work was conducted, for his unstinted interest and kindly criticism, and to Doctor D. H. Linder for many helpful suggestions throughout the progress of this problem.

Summary

A comparative morphological and biometrical study on artificial media, has been made of strains of *Conidiobolus villosus* obtained from the Farlow Herbarium, the Centraalbureau voor Schimmelcultures, and isolated directly from termites in Cuba. Furthermore, infection experiments have shown that the fungus which has hitherto been considered a saprophyte may adapt itself to a parasitic habit, especially on termites. The Derx strain from Holland, in contrast to the others, appears to be strictly saprophytic. Moreover, in the life-history of the species in question an additional stage has been observed which consists of the production of minute conidia borne at the tips of the spiny appendages of the villose conidia or "resting spores". For these reasons a new combination, *Entomophthora coronata* (Cost.) has been made and *Delacroixia coronata* and *Conidiobolus villosus* have been reduced to synonomy.

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[1] The writer prefers to use the generic name *Entomophthora* rather than *Empusa* since the latter has been used earlier (1824) for a genus of orchids and is untenable as a genus of the Entomophthoraceae according to Article 65 of the International Rules of Botanical Nomenclature, which reads, "A name of a taxonomic group is illegitimate and must be rejected if it is a later homonym, that is if it duplicates a name previously and validly published for a group of the same rank based on a different type. Even if the earlier homonym is illegitimate, or is generally treated as a synonym on taxonomic grounds, the later homonym must be rejected."

Explanation of Text Figures

All drawings were made with the aid of a camera lucida, from material mounted in lactophenol. Each division of the scale represents 10u.

Text Figure No. 1.

A-D. Martin or type strain.

A and B. Smooth-walled conidia showing range in size. X 500.

C and D. "Resting spore", or echinulate conidia. X 500.

E-H. Cuban strain.

E and F. Smooth-walled conidia. X 500.

G and H. "Resting spore", or echinulate conidia. X 500.

Text Figure No. 2.

A-G. Martin or type strain.

A. "Resting spore" showing development of minute conidia only on portion of peripheral area. X 500.

B-G. Successive stages in the development of the minute conidia. X 500.

B. Villose appendage.

C. Appendage swollen at distal end, a primary step in the formation.

D-F. Further changes in development.

G. Minute conidium just prior to discharge.

H. J. Derx Strain.

H. "Resting spore" with minute conidia on portion of peripheral area as in Martin strain, Fig. A. X 500.

I. Primary conidium giving rise to secondary by means of a germ tube. X 500.

J. "Resting spore" showing minute conidia on only portion of periphery as in figures A and H. X 500.

K. N. Cuban strain.

L and N. Germinating minute conidia. X 500.

M. "Resting spore" showing conidial development on entire peripheral area prior to septum formation and discharge. X 500.

PLATE IX

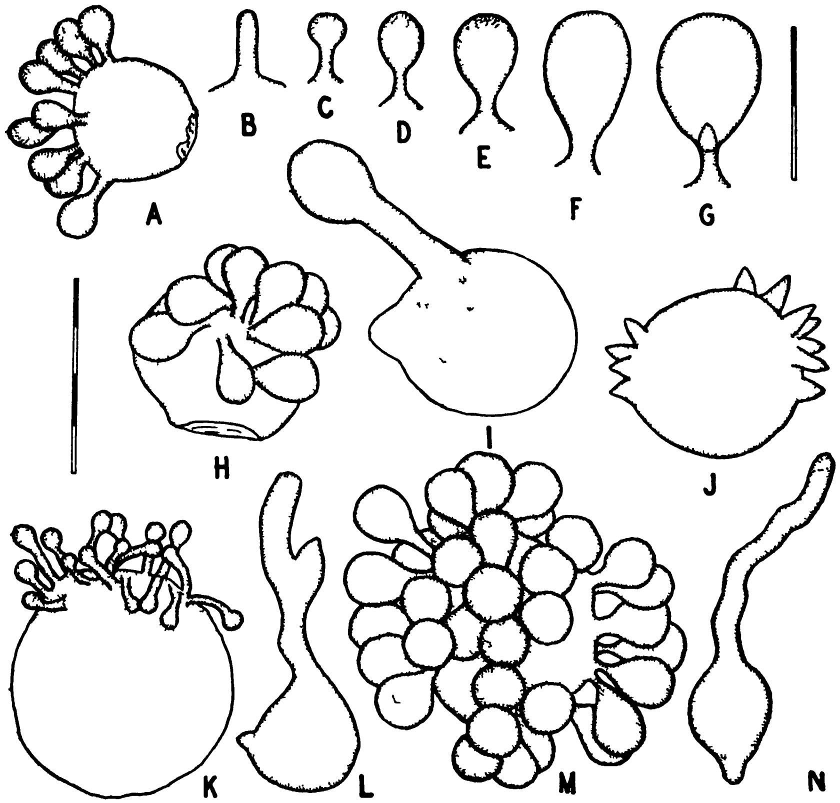


PLATE X

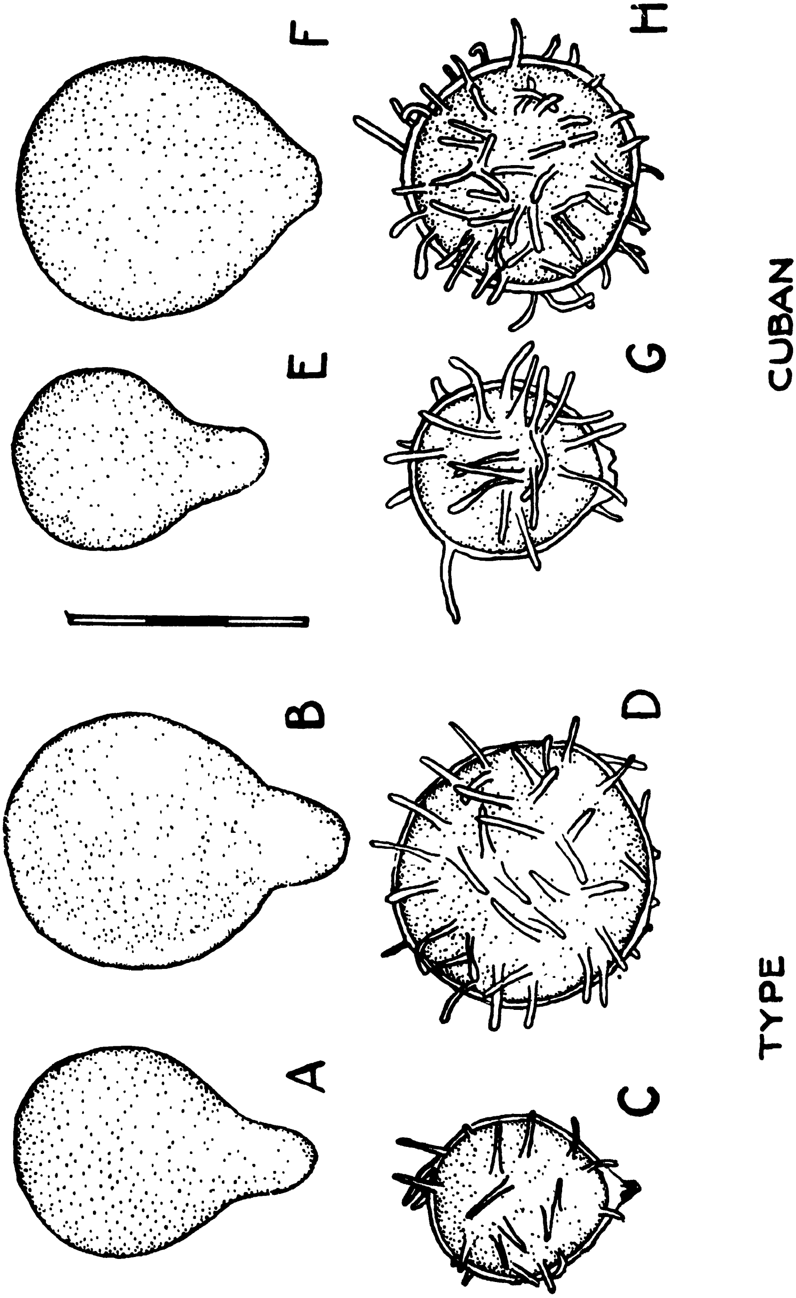
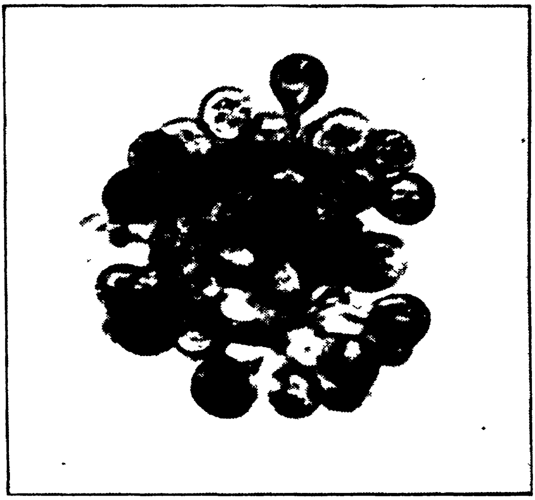


PLATE XI



Photomicrograph showing villose type of
conidium bearing the smaller micro-
conidia at the apical extremities
of the hair-like projections.

A COMPARATIVE STUDY OF THE STATISTICAL METHODS MOST COMMONLY USED IN AGRICULTURAL RESEARCH

By BERNARDO G. CAPÓ

INTRODUCTION

In statistical works the term *population* stands for a large group of individuals which possess one or more characteristics in common. These individuals may be persons, animals, numbers, leaves, etc., constituting respectively populations of persons, animals, numbers, leaves, etc.

The individuals themselves are different from one another and therefore the values which measure the intensity of any one of the characteristics common to all the individuals of a given population fluctuate between two limits: an upper and a lower one. These measurements, however, do not distribute themselves uniformly throughout all the range included between the limits, but on the other hand, their tendency is to distribute themselves in such a way that the number of values increase gradually from a very small number of them near the extremes to a very large number near the center of the distribution range.

The history of mathematical statistics has witnessed numerous attempts to explain by means of some mathematical formula or equation the exact way in which these values distribute themselves in naturally occurring populations. Among the curves represented by these equations the *normal curve* or *normal curve of error* has played a major role. Though inexact in itself, it is a close approximation to the exact distributions known as Binomial Law and Poisson Series, which in common with many other distribution curves, approach the normal curve as a limit, under certain conditions.

To graph the curve which represents any population of values normally distributed it is necessary to know the values of two *constants* or *statistics,* known as the *mean* and *standard deviation.*

The *mean* is equal to the sum of all the values divided by their total number, or in another way:

$$M = (X_1 + X_2 + X_3 + \ldots\ldots) / n$$

where M is the mean of the values that constitute the population, X_1, X_2, X_3, etc., are the individual values; and n is the number of values.

For example the sale-prices of some grapefruit lots sold at public auction in New York were as follows: 2.50, 3.37, 3.62, 4.00, 3.87,

and 3.75. The mean of these sale-prices is found by adding them together and dividing their sum by 6, which gives as result 21.11/6 = 3.52. This is of course, the mean of these six sale-prices, which is also an estimate of the true mean of the population of sale-prices represented by them.

The *standard deviation* or *standard error* of the individal values of a population is equal to the square root of the quotient obtained on dividing the sum of the squares of the differences between each value and the mean, by one less than the number of values, or in another way:

$$D = \sqrt{(X_1-M)^2 + (X_2-M)^2 + \ldots\ldots / (n-1)}$$

where D is the standard deviation of the values of the population and the other signs mean the same as in the previous formula.

Therefore, the estimate of the standard deviation of one of the sale-prices of the sale-price population represented by those of the preceding example is found as follows:

Values	Deviations from the mean (Differences between the values and the mean)	Squares of the Deviations
2.50	-1.02	1.0404
3.37	-0.15	0.0225
3.62	0.10	0.0100
4.00	0.48	0.2304
3.87	0.35	0.1225
3.75	0.23	0.0529
21.11 = Sum.		Sum of squares = 1.4787

Mean = 21.11/6 = 3.52 $\qquad$ 1.4787/5 = 0.2957

Standard Deviation = $\sqrt{0.2957}$ = 0.54.

Another way to find this estimate of the standard deviation which will be used on illustrating some of the statistical methods which will be described further on, is as follows:

	Values	Squares	
	2.50	6.2500	Correction = $(21.11)^2/6$ =
	3.37	11.3569	
	3.62	13.1044	= 445.6321/6 = 74.2720
	4.00	16.0000	
	3.87	14.9769	
	3.75	14.0625	Standard deviation = $\sqrt{0.2957}$ = 0.54
Sums	21.11	75.7507	
		- 74.2720	
		1.4787 / 5 = 0.2957	

The square of the standard deviation has been called by R. A. Fisher *variance* and since this term will be used frequently in the future, it is convenient to note its relation to the standard devia-

tion. In the preceding example the estimate of the variance of a single value of the population is equal to 0.2957.

In what follows it will be assumed that these estimates of the mean and standard deviation are equal to the real mean and standard deviation which could be calculated only from the values of all the individuals comprising the population; theoretically, an infinite number of values.

If twice the standard deviation of one of the values of the population under study is respectively added to and subtracted from the mean, there will be obtained two numbers which, if used as limits, will include between them about 95.45 per cent of the values which constitute the population. Therefore, the probability that any one of these values will fall by chance within these limits is of 95.45/100, where the total number of possibilities is unity.

Thus, then, in the previous example, if two times 0.54 or 1.08 is respectively added to and subtracted from 3.52, there will be obtained the quantities 4.60 and 2.44. If under similar conditions a large number of these sales were effected, it should be expected that 95.45 per cent of the sale-prices in these cases lie between 2.44 and 4.60, or the probability that any one of these sale-prices fall within these limits would be of 95.45/100.

In other words, 4.55 per cent of the values or sale-prices in sales made under similar conditions would be at prices lower than 2.44 or higher than 4.60, and of these, one-half would be at prices lower than 2.44. Thus, then, with this information one can deduct that of a large number of sales made under similar conditions, 2.28 percent will be made at prices lower than 2.44 and 97.72 per cent at prices higher than 2.44. It can also be deducted that under similar conditions the probability that a sale be made at a price higher than 2.44 against the probability that it be made at a price lower than 2.44 will be of 97.72 to 2.28 or of 43 to 1. Accentuating still more, it should be expected that 43 out of every 44 sales made under conditions similar to these will be made at prices higher than 2.44.

On the other hand, if it is desired to know the two limits (at equal distances from the mean) between which a certain percentage of the population is to be found, for example, 70 per cent, one must proceed as follows: If 70 per cent of the values fall within these limits, then 30 per cent of the values of the population will fall outside of them; or in other words, the deviations from the mean of 30 per cent of the values of the population will be larger than that which is sought, that is, than the deviation of the limits from the mean.

If one looks in the table of probabilities based on the normal curve, at the end of this article, it will be seen that in 30 per cent of the cases the deviations of the values from the mean exceeds 1.04 times the standard deviation or that the limits outside of which 30 per cent of the population lies are at distances from the mean equal to 1.04 times the standard deviation of the population. As in this case the standard deviation is 0.54, the limits will lie at distances from the mean equal to $1.04 \times 0.54 = 0.56$, and therefore they will be $3.52 - 0.56$ and $3.52 + 0.56$, or 2.96 and 4.08, respectively. In other words, 70 per cent of the population will lie between 2.96 and 4.08.

The relation which has given practicability to these formulas is the following fundamental postulate in all kinds of statistical methods: If a number of values are normally distributed around their mean with a standard deviation equal to D, then means of groups of *n* of these values will be distributed around their mean with a standard deviation equal to $D/\sqrt{n}$.

The standard deviation of the mean in the case of reference will then be $0.54/\sqrt{6} = 0.54/2.45 = 0.22$. This means that on subtracting from and adding respectively to the mean two times 0.22 or 0.44, the quantities 3.08 and 3.96 will be obtained, between which 95.45 per cent of the means of groups of 6 sales made under similar conditions lie. This postulate has given practicability to these formulas, not only for the fact that, as has been seen, the standard deviation of the mean of a number of values is smaller than the standard deviation of any one of them, and thus the value that another mean of the same number of values may have is fixed within narrower limits, but also because the mean represents the whole population.

The table of probabilities based on the normal curve, however, can be used only when the population is distributed normally and when the *exact* values of the mean and its standard deviation are known. However, as "Student" pointed out in 1908, with the necessarily limited number of values with which the research worker must work, be it in the laboratory or in the experimental field, it is impossible to determine exactly both the mean of the population which said values represent, and its standard deviation, being still more difficult to determine if the population is normally distributed or not. Therefore, if it is not possible to know exactly these facts, the use of the table of probabilities based on the normal curve becomes academic and loses all its utility.

For these conditions, however, "Student" developed another distribution curve which he called the distribution of "z", which

holds for the estimates of the mean and standard deviation as obtained from only a few values of the population, and, therefore, conclusions having a known degree of accuracy may be derived, even with some few values of observations, as in the case of a large part of the experiments performed by the investigators all over the world.

With these new tables, moreover, this can be done not only in those cases in which it is known that the means of groups of values distribute themselves normally with respect to their mean and standard deviation, but also in cases where the original values are distributed in a non-normal way, provided the departure from normality be not too wide. Therefore, the table of "z" has a very wide application, its use being of incalculable aid for the research workers in all branches of science.

R. A. Fisher has modified this table of "z" and obtained the distribution of $Z/\sqrt{n-1}$ which he has called "t". In Fisher's table of "t" the letter n means not the total number of values, but what he has called the *number of degrees of freedom*. This number of degrees of freedom is the number of values from a series of them which can be altered arbitrarily without altering their mean.

In the series of sale-prices the values have 5 degrees of freedom, since the total number of observations is 6, and if arbitrary values are assigned to 5 of them, the sixth value must have only one magnitude, if the mean is to remain equal.

With these new tables the problem of comparing the mean of the values which constitute a population with a certain fixed value and to determine the probabilities with which the mean will exceed said value is thus simplified. Thus, then, one can determine the probability with which a given fertilizer or cultivation treatment will produce yields that surpass a certain limit or with which the yield of a given variety of plants will exceed a given fixed value.

However, the object of the agricultural experiments in general is not to obtain varieties or treatments which will produce at least a certain fixed yield, but rather to determine which of any given number of these is the best under certain environmental conditions, or in case that there were two or more almost equal and better than the rest, which are these.

At present there are two general ways for making this selection in both of which the population whose mean is considered best, is compared successively with each of the other populations.

In the first of these ways one calculates the probability with which the difference between the means of the two treatments or

varieties to be compared is positive. This procedure is employed in what are known as Bessel's Method, Fisher's Method for the Analysis of Variance and Hayes Deviation from the Mean Method.

In the second of these ways one calculates the probability with which the mean of the differences between corresponding values of the two treatments or varieties to be compared is positive. This procedure is employed in what is known as "Student's" Method of Paired Results.

In what precedes the ways of estimating means and their standard deviations have been described. But now it has been seen that the estimates of the standard deviations of differences must be calculated also in the application of all those methods which calculate the probability with which the difference between the means is positive.

In order to do this the following relation is made use of: The standard deviation of the difference between any two means is equal to the square root of the difference between the sum of the variances of both means and twice the product of their standard deviations by the coefficient of correlation between the means they represent.

This is expressed mathematically as follows:

$$D_d = \sqrt{V_1 + V_2 \quad -2D_1D_2C}$$

where D_d is the standard deviation of the difference between the means, V_1 is the variance of one of the means and D_1 its standard deviation, V_2 is the variance of the other mean and D_2 its standard deviation, and C is the coefficient of correlation between the populations which the said means represent.

The method can be used then only to compare populations whose coefficient of correlation can be estimated with a certain degree of accuracy, for it cannot be determined exactly, due to the same reasons which hold for the values of the means and their standard deviations.

The labor which is needed to calculate this coefficient of correlation, in addition to the fact that in order that it may be calculated the experiment must comply with certain requisites, has made that the majority of the investigators use modifications of this method, of which there are some. In fact, the differences between these methods consist precisely in the different ways of modifying the application of this formula. These modifications will therefore be taken up in connection with the descriptions of the methods.

Before proceeding with the detailed descriptions of the methods there is still one point to be taken up, which is as follows. In order

that uniform conclusions may be derived from the interpretation of the same data by different investigators it has been accepted to consider as a statistically significant difference, that difference which has a probability in favor of its being positive of not less than 21/22. Since this is the probability that should be used on making the interpretation of agricultural experiments the tables of "z" and "t" for this probability have been calculated and reproduced at the end of this article.

These preliminary considerations, which seemed to be necessary for the practical use of the different methods in use at present being finished, it is now time to describe the different methods in order.

Bessel's Method

This method, as has been already said, belongs to those methods in which one calculates the probability with which the difference between the means of two populations is positive, that is, with which one of the populations will be better than the other, as witnessed by the means of the characteristic under study.

In this method the formula for the standard deviation of a difference between two means is modified by discarding altogether the term which contains the coefficient of correlation converting it into:

$$D_d = \sqrt{V_1 + V_2}$$

In order that this modification be correct, it is necessary that the conditions under which the experiment which is going to be interpreted in this way be such that the value of C, or coefficient of correlation between the populations to be compared, be so small that the term $2D_1D_2C$ be negligible. Under these conditions one has to calculate the means of the two populations to be compared and their variances and apply this formula.

To approximate these conditions as much as possible, it is the custom to distribute by chance throughout all the experimental field the different replications or repetitions of the treatments to be compared.

The diagram which follows represents the plan of an experiment performed under the direction of Mr. Fernando Chardón at Aibonito, P. R. The object of the experiment was to determine which of the seven fertilizer treatments tested would help to produce more tobacco leaf in a certain variety of tobacco at that region and under the then existing climatic conditions. The size of the plots was 1/50 of a *cuerda* (1 cuerda is 0.97 of an acre) and the yields are in hundredweights per *cuerda*.

DIAGRAM No. 1

B 8.38	D 9.00	A 7.45	G 8.03	F 9.69	E 9.50	C 7.92
F 9.64	G 8.86	D 9.84	E 9.55	A 8.91	C 8.44	B 8.20
D 9.39	A 9.73	E 10.00	C 10.34	G 8.75	B 8.06	F 7.61
G 10.03	E 10.30	B 8.36	F 8.41	C 9.59	A 7.58	D 8.44
C 9.22	F 7.95	G 7.06	A 8.36	B 9.70	D 9.45	E 8.98
E 7.98	C 8.70	F 8.69	B 8.97	D 9.09	G 7.69	A 7.63
A 7.30	B 8.23	C 6.98	D 8.22	E 9.13	F 7.36	G 8.03

Even though the distribution was such that there should be a repetition of each treatment in each file and column of the experimental field, that is, in the form of a Latin Square, as the repetitions for each treatment were distributed throughout all the experimental field, and within most columns and files the treatments were distributed by chance, it is to be expected that the correlation should not be too high and that the method of the modified formula may have here application. As these same results are to be used to illustrate the application of all the methods, one can assume for the present that the distribution was done by chance and that the results obtained were as appear in the diagram.

The means, their variances and standard deviations are calculated as explained in the preceding pages:

Treatment A—

Values	*Squares*	
7.45	55.5025	
8.91	79.3881	Mean $= 56.96/7 = 8.14$
9.73	94.6729	Correction of the sum of squares $= (56.96)^2$
7.58	57.4564	$= 3244.4416/7 = 463.4917$
8.36	69.8896	Variance of one value $= 4.9247/6 = 0.8208$
7.63	58.2169	Variance of the mean $= 0.8208/7 = 0.1173$
7.30	53.2900	Standard deviation of the mean $= \sqrt{0.1173} = 0.34$
56.96	468.4164	Yield of A $= 8.14 \pm 0.34$
	−463.4917	
	4.9247	

In the same way these values are found for the other treatments.

The yields of the different treatments in order as regards amount, are:

Treatment—E:	9.35 ± 0.29	Variance of the mean $= 0.0822$
Treatment—D:	9.06 ± 0.22	Variance of the mean $= 0.0468$
Treatment—C:	8.74 ± 0.45	Variance of the mean $= 0.1994$
Treatment—B:	8.56 ± 0.22	Variance of the mean $= 0.0483$
Treatment—F:	8.55 ± 0.32	Variance of the mean $= 0.1010$
Treatment—G:	8.35 ± 0.51	Variance of the mean $= 0.2628$
Treatment—A:	8.14 ± 0.34	Variance of the mean $= 0.1173$

As each one of the means of these treatments is based on 6 degrees of freedom there being 7 observations of each population, it is evident that the difference between any two of these means will be based on 12 degrees of freedom. Looking up in the table of "t" the ratio which corresponds to 12 degrees of freedom, for a probability of 21/22, one finds 1.83.

Now then, as the square root of the sum of the squares of two numbers must be greater than any one of the two numbers, and furthermore, as the difference between the means to be compared is to be compared with a number that is 1.83 times its standard deviation, it is evident that all the means of yields smaller than the largest but lying below it by not more than 1.83 times its standard deviation, will not give yields smaller than its yields in 21 cases out of 22.

Thus then, as the standard deviation of the mean 9.35 is 0.29, all the treatments whose means be less than 9.35 but more than $9.35 - 1.83 \times 0.29$ or $9.35 - 0.53 = 8.82$, will not be different in yield from treatment E, in at least 21 cases out of 22. That means that the method indicates preliminarily that treatment E gives not higher yields than treatment D in at least 95.45% of the cases, for the mean of the yield of D exceeds the inferior limit 8.82 already fixed.

The differences between the yields of treatment E and the other ones, are proved as follows as regards their statistical significance:

Between E and C:

Mean of E $= 9.35$		Variance of the mean of E	$= 0.0822$
Mean of C $= 8.74$		Variance of the mean of C	$= 0.1944$
Diff.	0.61	Variance of the diff.	$= 0.2766$

Standard deviation of the difference $= \sqrt{0.2766} = 0.52$

Amount which the difference must exceed to be significant

$$= 1.83(0.52) = 0.95$$

Since the difference does not exceed this limit, it is not significant.

In the same way are calculated the amounts to be exceeded by the differences between the mean of E and the means of B, F, G and A, concluding that treatment E is superior to treatments B, F and A.

Adding up, if one calculates the experiment under study by this method, that is, without making any correction for the error introduced on discarding the term which includes the coefficient of correlation in each comparison, one arrives at the conclusion that the treatments inferior to treatment E are treatments A, B and F and that there is no evidence as to statistically significant differences between treatment E and treatments D, C and G.

Note: There is a method which tries to eliminate the effects of soil heterogeneity by introducing check plots every three or four treatment plots. The fertility of the field is assumed to vary uniformly from one check plot to the other and the yields of the treated plots are then corrected by subtracting from each yield the respective yield which it would have produced if it were a check plot. The residues are then treated as above.

Once illustrated the preceding method, we will proceed to illustrate the method that uses the formula for the standard deviation of a difference without modifications of any sort. In this method, as has been already pointed out, one must calculate the coefficients of correlation between the different pairs of populations to be compared.

As the correlation of the yields is the result of the heterogeneity of the soil to the extent that the nearer two plots are from one another the larger will be the similarity between their autochthonous fertilities, and therefore, the larger the correlation between the yields of any pair of treatments applied in them, it is the custom when the said coefficient is to be used, to distribute the replications systematically throughout all the experimental ground in order that the replications of each treatment be within given distances from the respective replications of any other treatment at least in a major part of the replications.

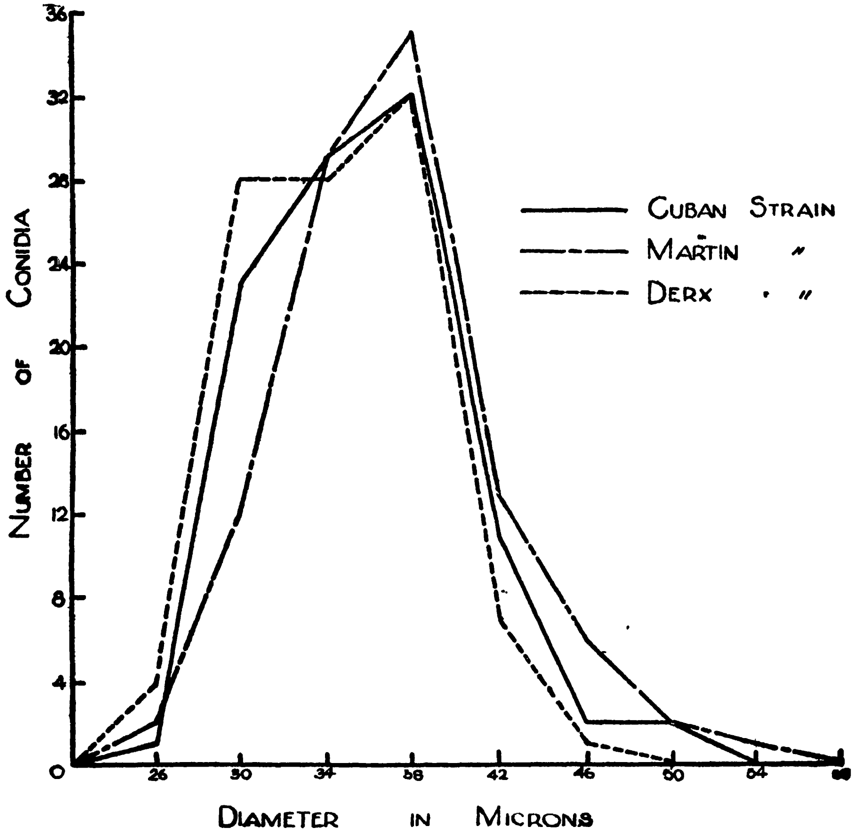
To calculate the coefficient of correlation between the two populations or series, there must be known first of all with which value of one of the series each value of the other one is respectively related. In other words, the individual values of both populations must be related in some specific manner and this relation must be known in order to calculate said coefficient.

even at the end of twenty-one days. These results immediately suggested that there was a physiological difference which distinguished the latter strain from the other two. In contrast, only one corn-borer was killed by the Cuban strain after ten days, while the others remained free from infection even after a longer period of exposure. In a similar experiment however *Empusa* sp., attacked approximately 40% of the larvae within the same length of time and under similar environmental conditions. The present experiments with the Cuban fungus on termites, together with the earlier work of Costantin (**3**) who was successful in infecting *Musca domestica* with his organism, demonstrates the fact that these reputedly. saprophytic fungi may live parasitically upon the proper hosts. Gallaud (**4**), however, using a variety of insects, was unable to find any evidence of parasitism, although when he placed dead cockroaches (Blatta) in contact with the spores he found that infection took place most readily in the muscles of the abdomen, thorax, and appendages.

Because the Derx culture behaved so differently from the other two in regard to parasitism it became necessary to study the morphological and physiological aspects of the various strains in order to determine what differences, if any, existed among them. In order to do this, the three strains of *Conidiobolus* and *Empusa* sp. were inoculated on the following substrata: Blakeslee's agar, sterilized carrots, egg yolk, swordfish, pork and liver. After a period of ten days, growth at room temperature, the Cuban strain and the type material of *C. villosus* were practically identical on the various media used. Growth of the Derx strain on egg yolk and liver was much more vigorous than the other strains, although on the remaining substrata it was noticeably more meager. Although the growth of *Empusa,* a recognized parasite, was less abundant on Blakeslee's agar, it was comparable in vigor with the development of *Conidiobolus* on the other substrata. It seems clear from the foregoing that the so-called saprophytic *Conidiobolus* is able to parasitize termites and conversely that the parasitic *Empusa* may be grown saprophytically on a variety of artificial media. Hence the existing differences between these two genera on this basis alone loses much of its weight.

Since differences in character of growth are so slight in all but the Derx strain of *Conidiobolus,* and since the organisms lack morphological distinctions, the writer made measurements of one hundred spores of the smooth type of each of the three strains in an endeavor to find a biometrical means of distinguishing them. The spores measured were produced on the same type of media and

under identical environmental conditions. It was noted that the spores of *Conidiobolus* from the three different localities were practically indistinguishable (Graph I), although those of the type strain



were 3 u. larger than the others. In view of our present knowledge of the fungi in question, it is doubtful if the Derx strain should be considered other than as a variant. Furthermore, the aforementioned organisms agree in nuclear condition as well as in their morphological and physiological behavior. Gallaud (**4**) has shown that *Delacroixia coronata* possesses multinucleate conidia while Martin (**6**) found the same to be true in *Conidiobolus villosus*. Moreover, the writer has confirmed Martin's findings not only in the type material but in the Cuban and Derx strains as well. In the genus *Empusa* a similar multinucleate condition has been shown in the conidia of a number of species investigated by Riddle (**9**), Cavara (**2**) and Olive (**8**).

The fact that *Conidiobolus villosus* and *Delacroixia coronata* have been shown to be similar morphologically, cytologically, and to a lesser extent physiologically, indicates that the confusion as to their taxonomy should be clarified.

Conclusions

As has already been stated, the genus *Delacroixia* was established to include a species of Entomophthoraceae with "spores en couronne". Gallaud, in 1905 encountered a fungus with spinose resting spores which Constantin identified as his *D. coronata* deviating from the type in only rarely producing the spores typical of the genus. Later, Martin (l. c.) described *Conidiobolus villosus* characterized by the villose appendages borne on the resting spores. The present writer has shown that these appendages are capable of giving rise to minute conidia similar to those of *D. coronata* and furthermore that the two fungi are similar morphologically and physiologically. There seems, therefore, no need of maintaining the later species, *C. villosus* as distinct.

Moreover, the genus *Conidiobolus*, founded by Brefeld (**1**) in 1884 was at that time thought to be readily distinguished from *Empusa* and *Entomophthora* by its saprophytic mode of existence. This, together with the fact that the strongly branched mycelium broke up into hyphal bodies early in the life cycle of the fungus, were the criteria upon which the genus was established. It has been shown elsewhere in this paper that at least certain strains of *C. villosus* may lead a parasitic mode of life in addition to a saprophytic one.

Furthermore other investigators, such as Speare (**11**), Molliard (**7**), and Sawyer (**10**), have shown that in the genera *Empusa* and *Entomophthora* a number of species which were considered obligate parasites, in reality are able to grow saprophytically. Undoubtedly other known species will be found to have a similar facultative saprophytism if investigators interested in growing them in artificial culture observe the cultural requirements revealed by Sawyer's work. The distinction supposed to exist between *Entomophthora, Empusa* and *Conidiobolus* is, therefore, lessened; as a matter of fact, material from artificial cultures of these genera, when examined under the microscope, cannot be distinguished morphologically with any degree of certainty until the resting spores appear. In addition, the micro-conidia in Thaxter's subgenus *Triplosporium* is another structural characteristic commonly found in certain species of each of the three

genera in question. In view of these facts, the writer believes that he is justified in making the new combination **Entomophthora coronata**[1] (Cost.) with the following as synonoms: *Boudierella Coronata* Cost., *Delacroixia coronata* (Cost.) Sacc. and Syd., and *Conodiobolus villosus* Martin.

In conclusion the writer wishes to express his indebtedness to Professor W. H. Weston, Jr., under whose direction this work was conducted, for his unstinted interest and kindly criticism, and to Doctor D. H. Linder for many helpful suggestions throughout the progress of this problem.

SUMMARY

A comparative morphological and biometrical study on artificial media, has been made of strains of *Conidiobolus villosus* obtained from the Farlow Herbarium, the Centraalbureau voor Schimmelcultures, and isolated directly from termites in Cuba. Furthermore, infection experiments have shown that the fungus which has hitherto been considered a saprophyte may adapt itself to a parasitic habit, especially on termites. The Derx strain from Holland, in contrast to the others, appears to be strictly saprophytic. Moreover, in the life-history of the species in question an additional stage has been observed which consists of the production of minute conidia borne at the tips of the spiny appendages of the villose conidia or "resting spores". For these reasons a new combination, *Entomophthora coronata* (Cost.) has been made and *Delacroixia coronata* and *Conidiobolus villosus* have been reduced to synonomy.

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[1] The writer prefers to use the generic name *Entomophthora* rather than *Empusa* since the latter has been used earlier (1824) for a genus of orchids and is untenable as a genus of the Entomophthoraceae according to Article 65 of the International Rules of Botanical Nomenclature, which reads, "A name of a taxonomic group is illegitimate and must be rejected if it is a later homonym, that is if it duplicates a name previously and validly published for a group of the same rank based on a different type. Even if the earlier homonym is illegitimate, or is generally treated as a synonym on taxonomic grounds, the later homonym must be rejected."

EXPLANATION OF TEXT FIGURES

All drawings were made with the aid of a camera lucida, from material mounted in lactophenol. Each division of the scale represents 10u.

Text Figure No. 1.

A-D. Martin or type strain.

A and B. Smooth-walled conidia showing range in size. X 500.

C and D. "Resting spore", or echinulate conidia. X 500.

E-H. Cuban strain.

E and F. Smooth-walled conidia. X 500.

G and H. "Resting spore", or echinulate conidia. X 500.

Text Figure No. 2.

A-G. Martin or type strain.

A. "Resting spore" showing development of minute conidia only on portion of peripheral area. X 500.

B-G. Successive stages in the development of the minute conidia. X 500.

B. Villose appendage.

C. Appendage swollen at distal end, a primary step in the formation.

D-F. Further changes in development.

G. Minute conidium just prior to discharge.

H. J. Derx Strain.

II. "Resting spore" with minute conidia on portion of peripheral area as in Martin strain, Fig. A. X 500.

I. Primary conidium giving rise to secondary by means of a germ tube. X 500.

J. "Resting spore" showing minute conidia on only portion of periphery as in figures A and II. X 500.

K. N. Cuban strain.

L and N. Germinating minute conidia. X 500.

M. "Resting spore" showing conidial development on entire peripheral area prior to septum formation and discharge. X 500.

A COMPARATIVE STUDY OF THE STATISTICAL METHODS MOST COMMONLY USED IN AGRICULTURAL RESEARCH

By Bernardo G. Capó

Introduction

In statistical works the term *population* stands for a large group of individuals which possess one or more characteristics in common. These individuals may be persons, animals, numbers, leaves, etc., constituting respectively populations of persons, animals, numbers, leaves, etc.

The individuals themselves are different from one another and therefore the values which measure the intensity of any one of the characteristics common to all the individuals of a given population fluctuate between two limits: an upper and a lower one. These measurements, however, do not distribute themselves uniformly throughout all the range included between the limits, but on the other hand, their tendency is to distribute themselves in such a way that the number of values increase gradually from a very small number of them near the extremes to a very large number near the center of the distribution range.

The history of mathematical statistics has witnessed numerous attempts to explain by means of some mathematical formula or equation the exact way in which these values distribute themselves in naturally occurring populations. Among the curves represented by these equations the *normal curve* or *normal curve of error* has played a major role. Though inexact in itself, it is a close approximation to the exact distributions known as Binomial Law and Poisson Series, which in common with many other distribution curves, approach the normal curve as a limit, under certain conditions.

To graph the curve which represents any population of values normally distributed it is necessary to know the values of two *constants* or *statistics*, known as the *mean* and *standard deviation*.

The *mean* is equal to the sum of all the values divided by their total number, or in another way:

$$M = (X_1 + X_2 + X_3 + \cdot \text{-----}) / n$$

where M is the mean of the values that constitute the population, X_1, X_2, X_3, etc., are the individual values: and n is the number of values.

For example the sale-prices of some grapefruit lots sold at public auction in New York were as follows: 2.50, 3.37, 3.62, 4.00, 3.87,

and 3.75. The mean of these sale-prices is found by adding them together and dividing their sum by 6, which gives as result 21.11/6 = 3.52. This is of course, the mean of these six sale-prices, which is also an estimate of the true mean of the population of sale-prices represented by them.

The *standard deviation* or *standard error* of the individal values of a population is equal to the square root of the quotient obtained on dividing the sum of the squares of the differences between each value and the mean, by one less than the number of values, or in another way:

$$D = \sqrt{(X_1-M)^2 + (X_2-M)^2 + \ldots\ldots / (n-1)}$$

where D is the standard deviation of the values of the population and the other signs mean the same as in the previous formulâ.

Therefore, the estimate of the standard deviation of one of the sale-prices of the sale-price population represented by those of the preceding example is found as follows:

Values	Deviations from the mean (Differences between the values and the mean)	Squares of the Deviations
2.50	-1.02	1.0404
3.37	-0.15	0.0225
3.62	0.10	0.0100
4.00	0.48	0.2304
3.87	0.35	0.1225
3.75	0.23	0.0529
21.11 = Sum.		Sum of squares = 1.4787

Mean = 21.11/6 = 3.52 1.4787/5 = 0.2957

Standard Deviation = $\sqrt{0.2957} = 0.54$.

Another way to find this estimate of the standard deviation which will be used on illustrating some of the statistical methods which will be described further on, is as follows:

	Values	Squares	
	2.50	6.2500	Correction = $(21.11)^2/6$ =
	3.37	11.3569	
	3.62	13.1044	= 445.6321/6 = 74.2720
	4.00	16.0000	
	3.87	14.9769	
	3.75	14.0625	Standard deviation = $\sqrt{0.2957}$ = 0.54
Sums	21.11	75.7507	
		- 74.2720	
		1.4787 / 5 = 0.2957	

The square of the standard deviation has been called by R. A. Fisher *variance* and since this term will be used frequently in the future, it is convenient to note its relation to the standard devia-

tion. In the preceding example the estimate of the variance of a single value of the population is equal to 0.2957.

In what follows it will be assumed that these estimates of the mean and standard deviation are equal to the real mean and standard deviation which could be calculated only from the values of all the individuals comprising the population; theoretically, an infinite number of values.

If twice the standard deviation of one of the values of the population under study is respectively added to and subtracted from the mean, there will be obtained two numbers which, if used as limits, will include between them about 95.45 per cent of the values which constitute the population. Therefore, the probability that any one of these values will fall by chance within these limits is of 95.45/100, where the total number of possibilities is unity.

Thus, then, in the previous example, if two times 0.54 or 1.08 is respectively added to and subtracted from 3.52, there will be obtained the quantities 4.60 and 2.44. If under similar conditions a large number of these sales were effected, it should be expected that 95.45 per cent of the sale-prices in these cases lie between 2.44 and 4.60, or the probability that any one of these sale-prices fall within these limits would be of 95.45/100.

In other words, 4.55 per cent of the values or sale-prices in sales made under similar conditions would be at prices lower than 2.44 or higher than 4.60, and of these, one-half would be at prices lower than 2.44. Thus, then, with this information one can deduct that of a large number of sales made under similar conditions, 2.28 percent will be made at prices lower than 2.44 and 97.72 per cent at prices higher than 2.44. It can also be deducted that under similar conditions the probability that a sale be made at a price higher than 2.44 against the probability that it be made at a price lower than 2.44 will be of 97.72 to 2.28 or of 43 to 1. Accentuating still more, it should be expected that 43 out of every 44 sales made under conditions similar to these will be made at prices higher than 2.44.

On the other hand, if it is desired to know the two limits (at equal distances from the mean) between which a certain percentage of the population is to be found, for example, 70 per cent, one must proceed as follows: If 70 per cent of the values fall within these limits, then 30 per cent of the values of the population will fall outside of them; or in other words, the deviations from the mean of 30 per cent of the values of the population will be larger than that which is sought, that is, than the deviation of the limits from the mean.

If one looks in the table of probabilities based on the normal curve, at the end of this article, it will be seen that in 30 per cent of the cases the deviations of the values from the mean exceeds 1.04 times the standard deviation or that the limits outside of which 30 per cent of the population lies are at distances from the mean equal to 1.04 times the standard deviation of the population. As in this case the standard deviation is 0.54, the limits will lie at distances from the mean equal to $1.04 \times 0.54 = 0.56$, and therefore they will be $3.52 - 0.56$ and $3.52 + 0.56$, or 2.96 and 4.08, respectively. In other words, 70 per cent of the population will lie between 2.96 and 4.08.

The relation which has given practicability to these formulas is the following fundamental postulate in all kinds of statistical methods: If a number of values are normally distributed around their mean with a standard deviation equal to D, then means of groups of n of these values will be distributed around their mean with a standard deviation equal to $D/\sqrt{n}$.

The standard deviation of the mean in the case of reference will then be $0.54/\sqrt{6} = 0.54/2.45 = 0.22$. This means that on subtracting from and adding respectively to the mean two times 0.22 or 0.44, the quantities 3.08 and 3.96 will be obtained, between which 95.45 per cent of the means of groups of 6 sales made under similar conditions lie. This postulate has given practicability to these formulas, not only for the fact that, as has been seen, the standard deviation of the mean of a number of values is smaller than the standard deviation of any one of them, and thus the value that another mean of the same number of values may have is fixed within narrower limits, but also because the mean represents the whole population.

The table of probabilities based on the normal curve, however, can be used only when the population is distributed normally and when the *exact* values of the mean and its standard deviation are known. However, as "Student" pointed out in 1908, with the necessarily limited number of values with which the research worker must work, be it in the laboratory or in the experimental field, it is impossible to determine exactly both the mean of the population which said values represent, and its standard deviation, being still more difficult to determine if the population is normally distributed or not. Therefore, if it is not possible to know exactly these facts, the use of the table of probabilities based on the normal curve becomes academic and loses all its utility.

For these conditions, however, "Student" developed another distribution curve which he called the distribution of "z", which

holds for the estimates of the mean and standard deviation as obtained from only a few values of the population, and, therefore, conclusions having a known degree of accuracy may be derived, even with some few values of observations, as in the case of a large part of the experiments performed by the investigators all over the world.

With these new tables, moreover, this can be done not only in those cases in which it is known that the means of groups of values distribute themselves normally with respect to their mean and standard deviation, but also in cases where the original values are distributed in a non-normal way, provided the departure from normality be not too wide. Therefore, the table of "z" has a very wide application, its use being of incalculable aid for the research workers in all branches of science.

R. A. Fisher has modified this table of "z" and obtained the distribution of $Z/\sqrt{n-1}$ which he has called "t". In Fisher's table of "t" the letter n means not the total number of values, but what he has called the *number of degrees of freedom.* This number of degrees of freedom is the number of values from a series of them which can be altered arbitrarily without altering their mean.

In the series of sale-prices the values have 5 degrees of freedom, since the total number of observations is 6, and if arbitrary values are assigned to 5 of them, the sixth value must have only one magnitude, if the mean is to remain equal.

With these new tables the problem of comparing the mean of the values which constitute a population with a certain fixed value and to determine the probabilities with which the mean will exceed said value is thus simplified. Thus, then, one can determine the probability with which a given fertilizer or cultivation treatment will produce yields that surpass a certain limit or with which the yield of a given variety of plants will exceed a given fixed value.

However, the object of the agricultural experiments in general is not to obtain varieties or treatments which will produce at least a certain fixed yield, but rather to determine which of any given number of these is the best under certain environmental conditions, or in case that there were two or more almost equal and better than the rest, which are these.

At present there are two general ways for making this selection in both of which the population whose mean is considered best, is compared successively with each of the other populations.

In the first of these ways one calculates the probability with which the difference between the means of the two treatments or

varieties to be compared is positive. This procedure is employed in what are known as Bessel's Method, Fisher's Method for the Analysis of Variance and Hayes Deviation from the Mean Method.

In the second of these ways one calculates the probability with which the mean of the differences between corresponding values of the two treatments or varieties to be compared is positive. This procedure is employed in what is known as "Student's" Method of Paired Results.

In what precedes the ways of estimating means and their standard deviations have been described. But now it has been seen that the estimates of the standard deviations of differences must be calculated also in the application of all those methods which calculate the probability with which the difference between the means is positive.

In order to do this the following relation is made use of: The standard deviation of the difference between any two means is equal to the square root of the difference between the sum of the variances of both means and twice the product of their standard deviations by the coefficient of correlation between the means they represent.

This is expressed mathematically as follows:

$$D_d = \sqrt{V_1 + V_2 \quad -2D_1D_2C}$$

where D_d is the standard deviation of the difference between the means, V_1 is the variance of one of the means and D_1 its standard deviation, V_2 is the variance of the other mean and D_2 its standard deviation, and C is the coefficient of correlation between the populations which the said means represent.

The method can be used then only to compare populations whose coefficient of correlation can be estimated with a certain degree of accuracy, for it cannot be determined exactly, due to the same reasons which hold for the values of the means and their standard deviations.

The labor which is needed to calculate this coefficient of correlation, in addition to the fact that in order that it may be calculated the experiment must comply with certain requisites, has made that the majority of the investigators use modifications of this method, of which there are some. In fact, the differences between these methods consist precisely in the different ways of modifying the application of this formula. These modifications will therefore be taken up in connection with the descriptions of the methods.

Before proceeding with the detailed descriptions of the methods there is still one point to be taken up, which is as follows. In order

that uniform conclusions may be derived from the interpretation of the same data by different investigators it has been accepted to consider as a statistically significant difference, that difference which has a probability in favor of its being positive of not less than 21/22. Since this is the probability that should be used on making the interpretation of agricultural experiments the tables of "z" and "t" for this probability have been calculated and reproduced at the end of this article.

These preliminary considerations, which seemed to be necessary for the practical use of the different methods in use at present being finished, it is now time to describe the different methods in order.

Bessel's Method

This method, as has been already said, belongs to those methods in which one calculates the probability with which the difference between the means of two populations is positive, that is, with which one of the populations will be better than the other, as witnessed by the means of the characteristic under study.

In this method the formula for the standard deviation of a difference between two means is modified by discarding altogether the term which contains the coefficient of correlation converting it into:

$$D_d = \sqrt{V_1 + V_2}$$

In order that this modification be correct, it is necessary that the conditions under which the experiment which is going to be interpreted in this way be such that the value of C, or coefficient of correlation between the populations to be compared, be so small that the term $2D_1D_2C$ be negligible. Under these conditions one has to calculate the means of the two populations to be compared and their variances and apply this formula.

To approximate these conditions as much as possible, it is the custom to distribute by chance throughout all the experimental field the different replications or repetitions of the treatments to be compared.

The diagram which follows represents the plan of an experiment performed under the direction of Mr. Fernando Chardón at Aibonito, P. R. The object of the experiment was to determine which of the seven fertilizer treatments tested would help to produce more tobacco leaf in a certain variety of tobacco at that region and under the then existing climatic conditions. The size of the plots was 1/50 of a *cuerda* (1 cuerda is 0.97 of an acre) and the yields are in hundredweights per *cuerda*.

DIAGRAM No. 1

B 8.38	D 9.00	A 7.45	G 8.03	F 9.69	E 9.50	C 7.92
F 9.64	G 8.86	D 9.84	E 9.55	A 8.91	C 8.44	B 8.20
D 9.39	A 9.73	E 10.00	C 10.34	G 8.75	B 8.06	F 7.61
G 10.03	E 10.30	B 8.36	F 8.41	C 9.59	A 7.58	D 8.44
C 9.22	F 7.95	G 7.06	A 8.36	B 9.70	D 9.45	E 8.98
E 7.98	C 8.70	F 8.69	B 8.97	D 9.09	G 7.69	A 7.63
A 7.30	B 8.23	C 6.98	D 8.22	E 9.13	F 7.86	G 8.03

Even though the distribution was such that there should be a repetition of each treatment in each file and column of the experimental field, that is, in the form of a Latin Square, as the repetitions for each treatment were distributed throughout all the experimental field, and within most columns and files the treatments were distributed by chance, it is to be expected that the correlation should not be too high and that the method of the modified formula may have here application. As these same results are to be used to illustrate the application of all the methods, one can assume for the present that the distribution was done by chance and that the results obtained were as appear in the diagram.

The means, their variances and standard deviations are calculated as explained in the preceding pages:

Treatment A—

Values	*Squares*	
7.45	55.5025	
8.91	79.3881	Mean = 56.96/7 = 8.14
9.73	94.6729	Correction of the sum of squares = (56.96)
7.58	57.4564	= 3244.4416/7 = 463.4917
8.36	69.8896	Variance of one value = 4.9247/6 = 0.8208
7.63	58.2169	Variance of the mean = 0.8208/7 = 0.1173
7.30	53.2900	Standard deviation of the mean = $\sqrt{0.1173}$ = 0.34
56.96	**468.4164**	Yield of A = 8.14 ± 0.34
	–463.4917	
	4.9247	

In the same way these values are found for the other treatments.

The yields of the different treatments in order as regards amount, are:

Treatment—E:	9.35 ± 0.29	Variance of the mean $= 0.0822$
Treatment—D:	9.06 ± 0.22	Variance of the mean $= 0.0468$
Treatment—C:	8.74 ± 0.45	Variance of the mean $= 0.1994$
Treatment—B:	8.56 ± 0.22	Variance of the mean $= 0.0483$
Treatment—F:	8.55 ± 0.32	Variance of the mean $= 0.1010$
Treatment—G:	8.35 ± 0.51	Variance of the mean $= 0.2628$
Treatment—A:	8.14 ± 0.34	Variance of the mean $= 0.1173$

As each one of the means of these treatments is based on 6 degrees of freedom there being 7 observations of each population, it is evident that the difference between any two of these means will be based on 12 degrees of freedom. Looking up in the table of "t" the ratio which corresponds to 12 degrees of freedom, for a probability of 21/22, one finds 1.83.

Now then, as the square root of the sum of the squares of two numbers must be greater than any one of the two numbers, and furthermore, as the difference between the means to be compared is to be compared with a number that is 1.83 times its standard deviation, it is evident that all the means of yields smaller than the largest but lying below it by not more than 1.83 times its standard deviation, will not give yields smaller than its yields in 21 cases out of 22.

Thus then, as the standard deviation of the mean 9.35 is 0.29, all the treatments whose means be less than 9.35 but more than $9.35 - 1.83 \times 0.29$ or $9.35 - 0.53 = 8.82$, will not be different in yield from treatment E, in at least 21 cases out of 22. That means that the method indicates preliminarily that treatment E gives not higher yields than treatment D in at least 95.45% of the cases, for the mean of the yield of D exceeds the inferior limit 8.82 already fixed.

The differences between the yields of treatment E and the other ones, are proved as follows as regards their statistical significance:

Between E and C:

Mean of E	$= 9.35$	Variance of the mean of E	$= 0.0822$
Mean of C	$= 8.74$	Variance of the mean of C	$= 0.1944$
Diff.	0.61	Variance of the diff.	$= 0.2766$

Standard deviation of the difference $= \sqrt{0.2766} = 0.52$

Amount which the difference must exceed to be significant

$$= 1.83(0.52) = 0.95$$

Since the difference does not exceed this limit, it is not significant.

In the same way are calculated the amounts to be exceeded by the differences between the mean of E and the means of B, F, G and A, concluding that treatment E is superior to treatments B, F and A.

Adding up, if one calculates the experiment under study by this method, that is, without making any correction for the error introduced on discarding the term which includes the coefficient of correlation in each comparison, one arrives at the conclusion that the treatments inferior to treatment E are treatments A, B and F and that there is no evidence as to statistically significant differences between treatment E and treatments D, C and G.

Note: There is a method which tries to eliminate the effects of soil heterogeneity by introducing check plots every three or four treatment plots. The fertility of the field is assumed to vary uniformly from one check plot to the other and the yields of the treated plots are then corrected by subtracting from each yield the respective yield which it would have produced if it were a check plot. The residues are then treated as above.

Once illustrated the preceding method, we will proceed to illustrate the method that uses the formula for the standard deviation of a difference without modifications of any sort. In this method, as has been already pointed out, one must calculate the coefficients of correlation between the different pairs of populations to be compared.

As the correlation of the yields is the result of the heterogeneity of the soil to the extent that the nearer two plots are from one another the larger will be the similarity between their autochthonous fertilities, and therefore, the larger the correlation between the yields of any pair of treatments applied in them, it is the custom when the said coefficient is to be used, to distribute the replications systematically throughout all the experimental ground in order that the replications of each treatment be within given distances from the respective replications of any other treatment at least in a major part of the replications.

To calculate the coefficient of correlation between the two populations or series, there must be known first of all with which value of one of the series each value of the other one is respectively related. In other words, the individual values of both populations must be related in some specific manner and this relation must be known in order to calculate said coefficient.

from St. Kitts in similar light plumage with a few dark feathers beginning to appear, indicating that the males when assuming the adult plumage attain red feathers on the throat before losing the body feathers of the immature plumage. Fully adult males from all these islands are much darker in color than those from Barbuda and Antigua. The single specimen from St. Martin agrees well in color with the series from St. Eustatius, and there is no doubt that the birds from these northern islands should be regarded as *coryi* instead of as *ridgwayi*, under which name they have hitherto been listed.

Birds from Nevis agree well with those from St. Kitts in color, but they average considerably larger and may represent a new subspecies, but unless further material corroborates this difference it seems best to regard the Nevis birds as *coryi*.

Apparently this bird sometimes breeds before attaining fully adult plumage, as a male just beginning to show red on the throat collected at Friar's Bay, St. Kitts on June 25, 1935 had its testes so enlarged as to indicate breeding.

Loxigilla noctis chazaliei Oustalet

Loxigilla Chazaliei Oustalet, Bulletin de la Société Zoologique de France, 20, 1895, p. 184. (Barbuda, collected by Count Dalmas, type probably in the Paris Museum.)

Subspecific characters: Similar in coloration to *L. n. coryi*, but the adult males are much lighter in color and smaller in size. They resemble *L. n. ridgwayi* most closely, but are smaller and lighter than that form. The under tail-coverts are chestnut-rufous. The immature males are of a lighter, more yellowish brown color above than those of any other form.

Measurements: Adult male. 5 specimens from Barbuda, wing 64.0–66.3 (64.84); tail (average of 4) 50.00–50.7 (50.30); culmen from base 14.5–15.5 (15.16); tarsus 17.3–21.0 (18.68). *Female.* 3 specimens from Barbuda, wing 61.8–68.9 (65.32); tail 45.0–53.5 (49.63); culmen from base 14.5–16.5 (15.53); tarsus 17.9–20.0 (18.96). *Immature male.* 3 specimens from Barbuda, wing 58.7–62.5 (60.73); tail 49.4–50.0 (49.67); culmen from base 15.0–15.7 (15.33); tarsus 16.5–19.4 (18.10).

Range: Restricted to the Island of Barbuda.

Specimens examined: Barbuda, 11.

Remarks: This is the lighest colored and the smallest of all the West Indian races of *L. noctis*. *L.n. ridgwayi* of Antigua is the form which most closely approaches it, but that is slightly larger and noticeably darker. The difference in color is even more noticeable in the field than in the museum, but even there the darkest Barbuda

bird was found to be lighter than the lightest Antigua bird, clearly demonstrating this to be a distinct and valid race.

Loxigilla noctis ridgway (Cory), Cat. W. Ind. Birds, 1892, p. 15, 112, 150, part. (Antigua, type in Field Museum, No. 9059, collected May 2, 1890 by C. S. Winch).

Subspecific characters: Similar to *L. n. coryi*, but decidedly lighter, the adult male being grayish black instead of pure black; the females and immature males are also paler. More similar to *L. n. chazaliei*, but larger and somewhat darker.

Measurements: Adult male. 14 specimens from Antigua, wing 61.6–67.8 (65.69); tail 48.5–53.2 (51.56); culmen from base 14.8:16.1 (15.31); tarsus 17.3–20.0 (18.27). *Female.* 2 specimens from Antigua, wing 59.6–66.3 (62.95); tail 50.5–51.4 (50.95); culmen from base 15.0–15.3 (15.15); tarsus 17.5–19.2 (18.35). *Immature male.* 2 specimens from Antigua, wing 63.5–63.7 (63.60); tail 51.0–51.6 (51.30); culmen from base 15.2–16.1 (15.65); tarsus 18.3–18.5 (18.40).

Range: Restricted to the Island of Antigua.

Specimens examined: Antigua, 18.

Remarks: Decidedly the lightest of all the West Indian races of *L. noctis* except *L. n. chazaliei*, than which it is somewhat darker and slightly larger.

Loxigilla noctis dominicana (Ridgway)

Pyrrhulagra dominicana, RIDGWAY, Auk, 15, Oct. 1898, p. 323 (Dominica, type in U. S. National Museum, No. 77829, collected by F. A. Ober at Mt. Lake, 2,500 feet altitude).

Subspecific characters: Similar to *L. n. coryi*, but much larger, and averaging darker, the adult males being consistently of a deep black color, with the under tail-coverts rufous or largely rufous. The females are also darker and more tinged with rufous above.

Measurements: Adult male. 18 specimens from Guadeloupe and Grande Terre, wing 67.2–74.3 (71.01); tail 49.0–57.2 (52.94); culmen from base 15.0–16.7 (15.61); tarsus 19.0–20.9 (20.16). 2 specimens from Marie Galante, wing 71.9–72.3 (72.10); tail 55.0–56.7 (55.85); culmen from base 14.8–15.3 (15.05); tarsus 17.6–20.0 (18.80). 12 specimens from Dominica, wing 71.4–75.3 (73.64); tail 52.7–60.0 (54.85); culmen from base 15.0–17.1 (15.77); tarsus 18.0–20.9 (20.03). *Female.* 1 specimen from Montserrat, wing 66.0; tail 47.3; culmen from base 15.7; tarsus 20.5. 24 specimens from Guadeloupe and Grande Terre, wing (average of 23) 64.0–70.1 (66.61); tail 46.3–52.3 (49.43); culmen from base (average of 20) 14.5–16.3 (15.26); tarsus (average of 22) 17.6–20.7 (19.25). 1 specimen from Marie Galante, wing 65.3; tail 48.4; culmen from base 15.0; tarsus 19.4. 10 specimens from Dominica, wing (average of 8) 64.8–70.3 (67.74); tail (average of 9), 45.3–51.0 (48.33); culmen from base (average of 9) 14.4–20.5 (16.28); tarsus 18.7–21.0 (19.98). *Immature male.* 3 specimens from Guadeloupe and Grande Terre, wing 66.7–67.9 (67.23); tail 47.2–49.0 (48.23); culmen from base 14.8–15.8 (15.20); tarsus 18.9–19.1 (19.00). 2 specimens from Dominica, wing 68.9–69.0 (68.95); tail 46.0–48.7 (47.35); culmen from base 15.7–16.8 (16.25); tarsus 19.9–20.8 (20.35).

Range: Guadeloupe and Grande Terre, Marie Galante, Dominica and probably Montserrat.

Specimens examined: Guadeloupe and Grande Terre 45; Marie Galante 3; Dominica 24; Montserrat 1.

Remarks: This is a very large and dark form, the largest of all the races of *L. noctis*. Specimens from Dominica average somewhat larger than those from the other islands particularly in the wing measurements, but these differences seem too slight to warrant subspecific recognition. No constant differences in color can be noted. As I have seen but one specimen (a female) from Montserrat, I am including that island doubtfully in the range of this race, although the specimen in question agrees fairly well with examples from Guadeloupe, and is probably referable to this form.

Loxigilla noctis desiradensis subsp. nov.

Type: Coll. Field Museum No. 23676, adult male, Desirade, March 7, 1886, collected by W. B. Richardson.

Subspecific characters: Similar to *L. n. dominicana* in color, but with shorter wing and tarsus.

Measurements: *Adult male.* 4 specimens from Desirade, wing 67.3–69.6 (68.35); tail 48.1–59.4 (54.60); culmen from base 15.5–15.9 (15.62); tarsus 17.4–20.0 (18.15). The type measures wing 68.0; tail 59.4; culmen from base 15.5; tarsus 17.4. *Adult female.* 2 specimens from Desirade, wing 62.0–65.5 (63.75); tail 47.0–49.2 (48.10); culmen from base 14.8–15.7 (15.25); tarsus 17.9–18.4 (18.15).

Range: Island of Desirade, near Guadeloupe.

Specimens examined: Desirade 6.

Remarks: This form is most closely related to *L.n. Dominicana*, but the wing and tarsus average decidedly shorter. In *dominicana* these average 72.06 and 20.02 respectively for adult males and 66.82 and 19.36 for females. Thus the wing of *desiradensis* averages 3.71 millimeters shorter in males and 3.07 millimeters shorter in females, while the tarsus averages 1.87 millimeters shorter in males and 1.21 in females.

Loxigilla noctis noctis (Linnaeus)

[*Fringilla*] *noctis* LINNAEUS, Syst. Nat., ed. 12, 1, 1766, p. 320 ("Jamaica", "Mexico", Martinique).

Subspecific characters: Similar in coloration to *L. n. dominicana*, but the adult males with the under tail-coverts chiefly black, sometimes with a little admixture of rufous or chestnut, and averaging very slightly smaller, while the females are lighter and less tinged with rufous above.

Measurements: Adult male. 20 specimens from Martinique, wing 67.0–73.0 (71.33); tail 49.7–54.1 (52.84); culmen from base 14.6–16.0 (15.33); tarsus 18.1–21.0 (19.65). *Female.* 5 specimens from Martinique, wing 65.6–68.8 (67.00); tail (average of 4) 48.6–52.0 (50.40); culmen from base 14.5–16.5 (15.40); tarsus (average of 2) 17.3–19.1 (18.20). *Immature male.* 1 specimen from Martinique, wing 67.9; tail 51.3; culmen from base 16.6; tarsus 19.3.

Range: Island of Martinique.

Specimens examined: Martinique 26.

Remarks: The adult males are quite similar to *L.n. dominicana*, differing chiefly in the small amount of rufous in the under tail-coverts. The females are lighter and less tinged with rufous above than those of *dominicana*, but darker and less olive than those of *L.n. sclateri*, being intermediate between the two, but very distinct from either.

Loxigilla noctis sclateri Allen

Loxigilla noctis sclateri. ALLEN, Bull. Nutt. Orn. Club, v, July 1880, p. 166 (St. Lucia, type in Museum of Comp. Zoöl., collected by John Semper, no date on label).

Subspecific characters: Adult males are similar in coloration to those of *L. n. noctis;* females and immature males are much lighter in color, being light olive above, and also lighter below; both sexes are smaller.

Measurements: Adult male. 45 specimens from St. Lucia, wing 65.8–71.6 (68.85); tail 46.3–55.0 (50.56); culmen from base 13.7–15.9 (14.74); tarsus (average of 4), 18.0–19.9 (18.92). *Female.* 15 specimens from St. Lucia, wing (average of 14) 62.8–67.9 (64.84); tail (average of 14) 44.5–52.6 (47.36); culmen from base 14.0–15.0 (14.52); tarsus 17.0–20.7 (18.75). *Immature male.* 2 specimens from St. Lucia, wing 64.5–64.6 (64.55); tail 44.0–46.0 (45.00); tarsus 18.7–19.6 (19.15); culmen from base 14.5–15.0 (14.75).

Range: Island of St. Lucia.

Specimens examined: St. Lucia 78 (including 16 unsexed birds measurements of which are not included).

Remarks: This form differs from *L.n. noctis* chiefly in its smaller size and the lighter coloration of the females and immature males, which are lighter than those of any other race with the exception of *L.n. ridgwayi* and *L.n. chazaliei.*

Loxigilla noctis crissalis (Ridgway)

Pyrrhulagra crissalis RIDGWAY, Auk, XV, Oct. 1898, p. 323 Cumberland Valley, St. Vincent, type in U. S. National Museum, No. 74083, collected Oct. 22, 1877 by F. A. Ober).

Subspecific characters: Similar to *L. n. dominicensis*, but slightly smaller, and the adult males are even deeper black; the chesnut-rufous area on the throat is more extensive, extending to the anterior portion of the chest; under tail-coverts rufous; females and immature males similar to those of *L. n. noctis*, but somewhat lighter, especially below.

Measurements: Adult male. 16 specimens from St. Vincent, wing 67.9–72.5 (70.05); tail (average of 15) 48.7:54.0 (50.57); culmen from base 14.4–16.5 (15.64); tarsus 17.8–20.5 (18.94). *Female.* 7 specimens from St. Vincent, wing (average of 5) 67.0–69.0 (67.98); tail (average of 5) 46.6–51.5 (49.00); culmen from base 14.4–15.6 (15.13); tarsus 18.0–20.4 (18.77). *Immature male.* 6 specimens from St. Vincent, wing 65.6–69.0 (67.11); tail 46.0–48.7 (47.40); culmen from base 15.6–16.1 (15.91); tarsus 18.3–19.9 (19.31).

Range: Island of St. Vincent.

Specimens examined: St. Vincent 29.

Remarks: This form, although very distinct, is most closely allied to *L.n. grenadensis* of Grenada, and may be distinguished by the characters mentioned under that species.

Loxigilla noctis grenadensis (Cory)

Pyrrhulagra noctis grenadensis Cory. Cat. W. Ind. Birds, 1892, p. 16, 112, 150, part (Grenada, type in Field Museum, No. 9041, without data, collected by J. G. Wells).

Subspecific characters: Similar to *L. n. crissalis*, but smaller; the adult males with the throat patch much more restricted and of a darker rufous color (with less of an orange tinge); under tail-coverts rufous, sometimes with admixture of black; the females are less olivaceous (more washed with brownish) above. The adult male has the iris dark brown; upper mandible dusky, the lower dark horn color; legs and feet slate gray, claws dusky, soles, tinged with yellow.

Measurements: Adult male. 38 specimens from Grenada, wing (average of 37) 65.3–70.1 (67.91); tail 45.5–53.0 (49.00); culmen from base (average of 36) 14.5:16.0 (15.23); tarsus (average of 37) 18.0–20.6 (19.25). *Female.* 12 specimens from Grenada, wing 62.5–66.8 (64.25); tail (average of 11) 44.0–49.3 (46.72); culmen from base 13.6–15.4 (14.39); tarsus 17.5–20.6 (18.62).

Range: Island of Grenada.

Specimens examined: Grenada 53 (including 3 unsexed specimens not measured).

Remarks:- This race resembles *L.n. sclateri* of St. Lucia in size and color more closely than *L.n. crissalis* of St. Vincent, with which form it has been proposed to unite it. The characteristics separating the latter two forms have been given under the subspecific characters. It may be noted that the type of *grenadensis* is an exceptionally dark

bird, darker than any other specimens examined from Grenada. It may not be out of place to mention here that, although this bird was formerly one of the most abundant birds in Grenada, it has now become decidedly scarce.

Loxigilla barbadensis Cory

Loxigilla barbadensis Cory, Auk, 3, July 1886, p. 382 (Barbados, type in Field Museum, No. 9047, collected February 4, 1886 by W. B. Richardson).

Specific characters: Similar in all stages to the female and immature stages of the lighter colored forms of *L. noctis,* being intermediate in color between *L. n. sclateri* and *L. n. ridgwayi,* but lacking the buffy or rusty tinge on the sides of the head and other parts, which is present in all forms of *L. noctis.*

Measurements: Adult male. 13 specimens from Barbados, wing (average of 11) 67.7–71.0 (69.29); tail (average of 11) 48.0–51.4 (49.93); culmen from base 14.9–16.5 (15.81); tarsus 18.1–21.5 (19.65). *Female.* 10 specimens from Barbados, wing (average of 8) 65.8–73.3 (69.74); tail (average of 8) 47.5–53.2 (50.15); culmen from base (average of 9) 14.9–15.8 (15.39); tarsus 18.1–20.5 (19.30). *Immature male.* 1 specimen from Barbados, wing 64.0; tail 45.0; culmen from base 14.4; tarsus 17.3.

Range: Island of Barbados.

Specimens examined: Barbados 24.

Remarks: This species is very closely allied to *L. noctis* and was in all probability derived from it. It differs from all forms of *L. noctis* in that the adult male never assumes the characteristic black and rufos plumage of that species, remaining in a plumage indistinguishable from that of the female. It greatly resembles the female and immature male of the lighter races of *L. noctis.*

STATUS OF THE PINK BOLLWORM IN PUERTO RICO DURING 1935–36

By L. C. Fife,
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Introduction

The production of Sea Island cotton in Puerto Rico, once an important industry, has been largely discontinued in recent years, partly because of the damage caused by the pink bollworm (*Pectinophora gossypiella* Saund.). In the year 1931 cotton plantings of the Sea Island variety covered an area of about 20,000 acres, Puerto Rico at that time being the world's largest producer. During the next three years no cotton was grown in Puerto Rico except 100 acres planted on the southern coast in September 1934 for seed. In 1935 approximately 2,000 acres and in 1936 about 3,000 acres were planted on the Island, the major part of these plantings occurring along the northern coast between Aguadilla and Arecibo.

In 1934 the Agricultural Division of the Puerto Rico Emergency Relief Administration started a project to assist in the rehabilitation of cotton-growing on the island. In view of the fact that the pink bollworm was one of the most important factors limiting the production of Sea Island cotton in Puerto Rico, this organization undertook a project to eradicate this pest. Wild cotton that grew abundantly in waste places and was the most important reservoir for the carry-over of the worms was almost eradicated by this organization in 1934–35. During that period 7,896,986 wild cotton plants were reported as having been destroyed.

Distribution

During 1935–36 the pink bollworm occurred throughout the commercial cotton-growing region along the northern coast, i. e., from Aguadilla to Arecibo. On the southern coast cultivated cotton was found infested only at Boquerón (La Costa) and at Sabana Grande, on the extreme southwestern part of the Island. Although small plantings of cotton were made also at Ponce, Juana Díaz, Villalba,

[1] In cooperation with the Puerto Rico Experiment Station of the United States Department of Agriculture.

Lajas, and Peñuelas they were not infested. A rather heavy infestation was found on wild cotton along the coast at Fajardo, Yabucoa, and Naguabo, on the extreme eastern part of the Island, and at Arroyo on the southeastern coast. Wild cotton was found infested also at Lajas and at Mayagüez. It appears that the pest's presence on the east and southeast coasts represents a separate infestation, probably from moths carried by air currents from adjacent islands on the east. The pink bollworm was not found on cotton in the interior of the Island. However, no commercial cotton plantings occur in the interior and very few wild cotton plants can be found in that part.

INFESTATION

Since the pink bollworm infestation in 1935 was rather low and occurred late in the season, the damage to cultivated cotton by this pest was negligible. At the time of the highest infestation of that year (December), the boll infestation per field averaged 30.2 percent and ranged from 3 to 95 percent. The principal reasons for this low infestation were as follows: (1) No cultivated cotton had been grown commercially in Puerto Rico during the previous 3 years; (2) wild cotton had been almost eradicated from the island in 1934–35; (3) no other favorable or preferred host plants occur in sufficient numbers to maintain a high population density of the pink bollworm in the absence of commercial cotton plantings over a period of 3 years.

In 1936 the pink bollworm infestation was unusually high throughout the commercial cotton-growing regions of the northern coast, except at Arecibo. As early as April of that year the boll infestation per field averaged 21.6 percent and ranged from no infestation at Arecibo to 63 percent at Isabela. A few fields in the latter locality, including an area of about 30 acres, were completely destroyed by June and the plants in several other fields were so badly damaged that they were pulled up before many bolls had opened. In August 27 fields were examined between Aguadilla and Arecibo. At that time the boll infestation per field averaged 24.3 percent and ranged from no infestation in two fields at Camuy to 100 percent in three fields at Isabela. Although no infestation counts were made in October, it was obvious that all fields were heavily infested at that time. Not less than 50 percent of the crop was destroyed in the district of Isabela and at least 30 percent over the entire cotton-growing area. The following were the principal reasons for this high infestation: (1) A very short dead season, if

any, was provided between the 1935 and 1936 crops, this permitting the pink bollworm to build up a dense population late in the season, thereby increasing the total number of long-cycle larvae to infest the 1936 crop; (2) fields were not thoroughly and immediately cleaned up after the harvest; (3) a high proportion (at least 65 percent) of the larvae in open cotton bolls were of the long-cycle type and the duration of this inactive stage for a maximum period of 172 days resulted in a very high carry-over; (4) although the seed capsules of Maga (*Montezuma speciosissima*) and Clamor (*Thespesia populnea*) were not heavily infested, these plants were factors in maintaining this pest during the dead season; (5) a considerable quantity of infested planting seed was used.

In 1935–36 the pink bollworm infestation on the southern coast was rather low. On cultivated cotton, infestation was found only at Boquerón and Sabana Grande. On eight fields examined in May, the boll infestation per field averaged 12.9 percent, and ranged from no infestation to 37 percent. In one field examined at Boquerón on June 4, however, the boll infestation was found to be 86 percent.

The geographic position of Puerto Rico is such that climatic conditions favor the development of the pink bollworm throughout the year. The long growing period is favorable to the increase of this species and is the most important factor affecting the abundance of this pest on cultivated cotton from year to year.

THE INTRODUCTION OF PARASITES OF THE SUGARCANE BORER INTO PUERTO RICO

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In July 1935, when the Bureau of Entomology and Plant Quarantine began by use of special funds, the study of certain insect pests of Puerto Rico the, writer was assigned to the Division of Foreign Parasite Introduction and delegated to exploratory work in the British West Indies and in South America. His primary objective was to secure the natural enemies of the sugarcane borer (*Diatraea saccharalis* Fab.) for the control of this pest in Puerto Rico. Incidental thereto, shipments of certain species were also made to the United States. The work was begun in Trinidad, B. W. I., on August 12, 1935, and terminated in Peru on May 22, 1936.

INVESTIGATION IN TRINIDAD

In addition to *Diatraea saccharalis,* there are two other species in the same genus that are important pests of sugarcane in Trinidad. As a matter of fact both of them, *D. impersonatella* Walk. and *D. canella* Hamps., have been much more serious there for several years than *saccharalis*. In all the writer's collections of borers for the rearing of parasites the numbers of *impersonatella* and *canella* far exceded those of *saccharalis*.

The actual collecting and rearing of borers was begun on August 26 and continued to the middle of October 1935. The collection of borers was confined to dead hearts of sugarcane. During these 7 weeks 17,630 dead-heart shoots of sugar cane were collected, and they produced, upon dissection, 639 pupae and 4,653 larvae of the three species. No parasites emerged from the pupae, but three species of larval parasites were reared. The commonest of them was the fly *Theresia claripalpis* Van der Wulp, parasitizing 9.2 percent of the borers; the fly *Stomatodexia diadema* Wied. was responsible for killing 1.1 percent, and the braconid *Apanteles diatraeae* Mues., about 0.05 percent. This braconid is said to be more common on *Diatraea* spp. attacking rice in Trinidad, killing 100 times as many as it attacks in cane. *Stomatodexia* is believed to be a

seasonal parasite, being more common in the summer than in the fall. The writer's work was apparently begun just too late to reveal the true effectiveness of this dexiid.

No parasites were forwarded from the rearings in Trinidad. While the work there was in progress three trips were made to other countries to arrange for the conduct of projects, and, what is more important, although nearly 500 puparia and cocoons of the three species of parasites were obtained, at no time was the emergence of adults sufficiently large to justify air-express shipments.

In connection with the rearing of the dipterous parasites it might be mentioned that neither *Theresia* nor *Stomatodexia* adults would mate when placed in cages covered with white, coarse mosquito netting, but when the cages were painted green mating was induced. The cages were cylindrical, 14 inches in diameter and about 22 inches in height. As a precaution against molestation by ants, they were suspended from the ceiling of the laboratory, and were doubly protected from them by the use of sticky tree-banding material.

Investigations in British Guiana

The work in British Guiana had two distinct phases, the breeding of the Amazon fly (*Metagonistylum minense* Towns.) and the rearing of the parasites of the sugarcane borer indigenous to British Guiana.

In 1932, while in search of beneficial insects for the control of the large moth borer *Castnia licoides* Boisd. in the jungles of the Amazon basin in Brazil, J. G. Myers, of the Imperial Bureau of Entomology, discovered a new parasite attacking the larvae of *Diatraea saccharalis* infesting the two grasses *Paspalum repens* and *Echinochloa polystachya* about 500 miles from the Atlantic Ocean. His attempt to bring this unknown parasite with him into British Guiana that year failed on account of transportation difficulties. This obstacle was overcome the following year when the British Guiana Sugar Producers' Association, anxious to cooperate with the British Guiana Department of Agriculture, volunteered to purchase a launch and hire an experienced navigator to operate it. Thus, in the summer of 1933, Dr. Myers succeeded in bringing 200 adults of *Metagonistylum* into the entomological laboratory at Georgetown, Demarara. It cost the combined treasuries of these two organizations approximately $35,000 to get those 200 individuals of the Amazon fly. Yet it was an investment of inestimable value! During the short time since its introduction and colonization in the cane fields

of the country it has saved the sugar growers many times that amount. The justification of their faith in this parasite is amply demonstrated to one who visits the sugarcane fields on the plantations where liberations were made. It may be seen in abundant numbers everywhere. In 1934 it was introduced into the Island of St. Lucia, where its establishment, dispersion, and control of the borer, as observed by the writer, may be said to be phenomenal. As soon as arrangements had been completed for securing material for importation into Puerto Rico and the United States, all efforts were concentrated on breeding and sending as many adults as possible to assure adequate numbers for establishment.

Particular acknowledgment is due to the Hon. J. Sidney Dash, Director of the Department of Agriculture of British Guiana, and to the British Guiana Sugar Producers' Association, for permission to collect material in colonized areas and for aid given during the course of the rearing work.

The breeding of the Amazon fly involved the careful mating of the female, the dissection of her ovaries at the end of the gestation period of 7 days to secure first-stage maggots, the inoculation of the *Diatraea* borers with these maggots, the care of the inoculated borers during the period of development of the fly maggot, and the removal and care of the resulting puparia and of the adults emerging from them.

The airplane schedule in effect during the period of the operations in British Guiana called for only weekly service to Puerto Rico. Beginning October 29, ten shipments were made at weekly intervals, representing a total of 6,575 adults of *Metagonistylum*, of which 88.6 percent reached their destination alive. In some of these consignments two other species of *saccharalis* parasites were included in small numbers. Out of 8 adults of *Stomatodexia diadema* and 62 adults of *Bassus stigmaterus* (Cress.), all except 1 *Bassus* were alive upon reaching Puerto Rico.

Literature records at least 12 species of parasites of *Diatraea saccharalis* larvae and pupae indigenous to British Guiana. Bulk rearings of sugarcane borers were undertaken in the expectation that at least some of these species would be found in sufficiently large numbers to permit an attempt at their establishment in Puerto Rico. Arrangements were made with four sugar plantations, located in different parts of the country, for the collection of *saccharalis* larvae and pupae, which were to be forwarded daily to the laboratory at Georgetown. The entire month of December 1935 was devoted to this work. More than 13,000 borers (of all stages) and pupae of

the sugarcane borer were reared in the laboratory; yet only two species of parasites were recovered. These were *Bassus stigmaterus* and the recently introduced Amazon fly, both parasites of the larvae. It was indeed surprising that not a single individual of the many other species recorded from this country was obtained from such a large and representative mass of material.

Investigations in Peru

In developing the project it was considered wise to introduce parasites from regions of diverse climatic conditions. The Amazon fly obtained in British Guiana has a decided preference for swampy or semiswampy conditions. This may be accounted for by the fact that its original home is along the banks of the Amazon River and it attacks its host inhabiting the grasses in the swamps bordering the river. One reason for the selection of Peru for the conduct of our search for the beneficial insects of the sugarcane borer was its climate, which was in marked contrast to that in British Guiana. Much of the sugarcane in Peru is grown in certain of the numerous valleys along its extensive west coast. Although very near the equator, the climate is subtropical, owing to the cooling effects of the Humboldt current from the Antarctic Ocean. For practically its entire length of 1,300 miles this coastal belt is almost rainless and is virtually destitute of vegetation except where irrigation makes cultivation possible. Most of these valleys are intensely cultivated and rendered fruitful by extensive systems of irrigation.

Three species of *Diatraea* are recorded from Peru, but only *saccharalis* is of economic importance. Two of the four parasites of *saccharalis* indigenous here, the dexiid fly *Theresia claripalpis* and the wasp *Ipobracon rimac* Wolc., were found in extraordinary abundance during the period of operation in Peru, April 7 to May 21, 1936. Both species were found in all the cane and numerous corn fields in the region about Trujillo. More than 12,000 puparia of the dexiid fly were accumulated in 3 weeks, and more than 13,000 adults of the wasp were collected in 29 days.

All the field-collected wasps and the adults emerging from the collection of puparia were cared for in a large storage cage of cheese-cloth, having a wooden frame 6½ by 6½ by 3 feet, until ready to be shipped. The upper frame and the uprights of the cage, towards the course of light, were literally covered with cubes of white sugar as food, and water was furnished by wetting the cheese-cloth on the sides of the cage and every 2 hours throughout the day. The

humid atmosphere produced in the cage by this wetting made the sugar more easily available to the adults.

The adult wasps and flies were shipped to their destinations in distinct types of cages. Metal cylindrical containers were used for *Theresia,* and wooden cages of the type used in the United States for shipping the parasites of the oriental fruit moth were utilized for *Ipobracon.* On the morning of the days of departure of the airplanes the parasites were prepared for shipment. Each insect was examined before being placed in the container, a practice which the writer has strictly followed in all shipments from foreign countries, and is specially necessary in the case of field-collected material. Since Peru had more frequent airplane service than British Guiana, it was possible to forward two consignments each week. A total of 13,533 adults of *Ipobracon rimac* were shipped from Peru, of which 10,705 went to Puerto Rico and the remainder, 2,828 adults, to the United States. The mortality en route to Florida was 21 percent, while to Puerto Rico, a trip requiring 2 days longer, it was 24.1 percent. In each case the mortality among the females was greater than among the males. Eighty-one percent of the adult wasps forwarded from Peru were females and only 19 percent males. Three hundred and fourteen adults of *Theresia claripalpis* were sent to Florida with a loss of 20.4 percent, while the mortality en route for the 1,713 flies shipped to Puerto Rico was 66.5 percent. For the four that reached Puerto Rico according to schedule the mortality was only 32.4 percent, but three of the consignments were misrouted or otherwise delayed, with consequent heavier mortalities.

Summary

Search for the parasites of the sugarcane borer (*Diatraea saccharalis* Fab.) was conducted in five countries in the American Tropics, in three of which actual field and laboratory work was performed. Three dipterous and two hymenopterous parasites were found and shipped to Puerto Rico and Florida, the former receiving 19,063 adults and the latter 3,142. The shipments to Puerto Rico comprised 8,296 flies and 10,767 wasps, while the shipments to Florida totaled 314 flies and 2,828 wasps.

THE IMPORTATION OF COCCINELLID ENEMIES OF DIASPINE SCALES INTO PUERTO RICO

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One of the projects assigned to the writer in his recent investigations of beneficial insects in the American Tropics was the introduction of the predators of the coconut scale (*Aspidiotus destructor* Sign.) into Puerto Rico. This had been considered desirable in view of the presence of that pest in destructive numbers in Puerto Rico and the phenomenal success attained in its control in the Fiji Islands shortly after the introduction of coccinellids from Trinidad, B. W. I., in 1928. While this work was under way it was found possible to secure sufficient numbers of the different predators to provide shipments to Florida for use against the same pest and to California for testing upon the California red scale (*Chrysomphalus aurantii* Mask.).

The coconut palm is found throughout the Island of Puerto Rico, but extensive groves occur only along the seacoast, especially on the eastern and northeastern shores. Not only is *Aspidiotus* present wherever the coconut palm grows, but it attacks a dozen or more additional host plants. In Florida *A. destructor* is recorded from the southerly end of the peninsula and according to Merrill and Chaffin (1) it infests banana, mango, coconut, date, and Chinese fan.

COCCINELLID PREDATORS IN TRINIDAD

In Trinidad the coconut as an agricultural product is surpassed in importance only by cacao and sugarcane. In the southwestern corner and along practically the entire eastern shore of the island coconuts are grown almost to the exclusion of other crops. Numerous large plantations are scattered along the northern shore and in the northwestern corner of the island, as well as to the leeward of the northern range of mountains. Smaller groups of the palm may be found in other parts of the island. Nowhere are these trees free from the coconut scale. In the spring of 1936, however, although the infestation was general in distribution, the intensity was variable.

At least five species of coccinellid beetles have been recorded as predators on *Aspidiotus destructor* in Trinidad. Taylor (2) lists

them as *Cryptognatha nodiceps* Marsh., *C. simillima* Sic., *Azya trinitatis* Marsh., *Scymnus aencipennis* Sic., and *Pentilia insidiosa* Muls. The present writer's investigations revealed three others, two being species of *Hyperaspis* and the third still undetermined. The species known in Trinidad as *Pentilia insidiosa* has been determined by coleopterists of the Bureau of Entomology and Plant Quarantine to be *Pentilia castanea* Muls., and by those of the California Citrus Experiment Station as *Azya trinitatis* Marsh. To avoid confusion the species will be referred to in this article as *Pentilia castanea.*

Two of the eight species represented in the writer's field collections overwhelmingly outnumbered all the others, nearly 90 percent of the insects shipped being *Cryptognatha nodiceps* and *Pentilia castanea* in about equal abundance. The former was common throughout the island and appeared in varying numbers in all the daily collections. In one region, however, it was exceeded in the numbers collected by *P. castanea.* In the groves along the eastern shore between Manzanilla and Biche and for 2 or 3 miles south of Biche, *Pentilia* was found in extraordinary abundance late in February and early in March, being fully three times as numerous as *nodiceps.* The other species encountered appeared to play an insignificant role in the control of *Aspidiotus,* and were never found in large numbers, at least not during the period of the writer's activities from January to March 1936. Yet, however small the representation of these minor species in the collections, they were always included in the shipments in the hope that under the conditions of their new envoronment they might become important factors in the control of this or some related pest. The two dominant species appeared to be much more scarce in the inland coconut groves than in those along the shore, despite the absence of any appreciable difference in the intensity of *Aspidiotus* infestation. Was this due to soil conditions, to their isolation from the large groves, or to other undetermined factors? It would have been interesting to study the reasons for this condition, but time did not permit.

Collection and Shipment

In the field the beetles were collected in 4-inch glass vials. The daily collections were placed in cylindrical glass jars, 8 inches in diameter and 12 inches high. Some of these jars contained coconuts, one to each jar, and others coconut fronds, heavily infested with *Aspidiotus.* This food was changed as necessary. Moisture was furnished daily by wetting the cheesecloth coverings of the jars.

When sufficient numbers had accumulated to warrant an air-express shipment, the beetles were packed and shipped.

In Trinidad, as in many other tropical countries visited, Caucasian peoples sleep in beds sheltered by mosquito netting. Such protective covering is sometimes cylindrical and narrow at the top but wide enough at the bottom to cover the bed on all its sides, and sometimes rectangular, conforming to the size and shape of the bed. Such protection in vogue at the Imperial College of Tropical Agriculture, where the writer made his headquarters, was of the latter type, and in his work in Trinidad it served a double purpose. At night it eliminated annoyance by mosquitoes and numerous other similar pests, and the days that the beetles were to be prepared for shipment it provided a convenient cage for the separation of the species. The jars containing the adults were placed under this netting and the beetles allowed to escape a few at a time. As they alighted on the sides of the netting towards the source of light from the windows, they were gathered in 4-inch vials, five adults to a vial. When 10 to 15 vials contained their quota of beetles, they were taken to the window, examined, and classified, the numbers of each species being recorded, and were then placed in the shipping containers. The operation was repeated until all the beetles were examined.

The shipping containers were of the usual mailing-tube type used by Bureau workers in the United States. Additional roosting surface was provided in each by the insertion of a tightly fitting triangular piece of chicken wire (¼-inch mesh) cut to size. Within its meshes were securely held two pieces of dental wick saturated, but not dripping, with a very dilute solution of sugar and water, to furnish water, humidity, and food. No host scales or any other food was furnished. The tubes were then wrapped in corrugated paper, and within its folds a slip of paper was placed bearing the numbers and species of the beetles therein, the dates and places of collection, the date of shipment, etc. In addition to the name and address of the consignee the following labels also were pasted on the outside of the package: "Permit of Entry of Beneficial Insects into the United States," "Rush," "Fragile," and "Handle with Care—Live Insects." Air express was used in all shipments.

Species Shipped and Their Numbers

Six consignments were forwarded from Trinidad, two of which went to Puerto Rico for liberation and breeding, two to Florida for direct liberation, and two to California for breeding in the laboratory

and subsequent release in the spring. Both consignments to Puerto Rico were reported to have arrived in excellent condition. The first of the two lots sent to Florida also reached its destination in excellent condition and with only 2 percent mortality. The second shipment, however, was not released for several days after arrival owing to inclement weather, with a consequent heavy mortality of 73 percent. The first lot of beetles sent to California was a total loss, having frozen to death en route owing to misrouting somewhere in the United States. The second shipment had suffered a mortality of 52 percent upon reaching Riverside, Calif.

The numbers of the various species sent to the several destination, with the dates on which the shipments left Trinidad, are given in Table 1. Among the 11 individuals of unknown species included in the second consignment to California two species of *Hyperaspis* were represented, according to determinations by P. H. Timberlake.

TABLE 1.—SPECIES AND NUMBERS OF COCCINELLID BEETLES SHIPPED FROM TRINIDAD TO PUERTO RICO AND THE UNITED STATES

Species	Number of beetles shipped to—									
	Puerto Rico			Florida			California			Total
	Jan. 19	Jan. 27	Total	Feb. 10	Mar. 10	Total	Feb. 16	Mar. 10	Total	
Cryptognatha nodiceps	147	126	273	156	149	305	174	111	285	863
Cryptognatha simillima	30	17	47	3	2	5	4	14	18	70
Pentilia castanea	38	30	68	25	595	620	46	111	187	875
Azya trinitatis	4	7	11	0	0	0	0	1	1	12
Scymnus aeneipennis	3	14	17	6	16	22	0	66	66	105
Unknown	6	9	15	9	0	9	18	11	29	53
Total shipped	228	203	431	199	762	961	242	344	586	1,978
Received alive	203	197	400	194	204	398	0	163	163	961
Percent alive	89.0	97.0	92.8	97.5	26.8	41.4	0	47.4	27.8	48.6

PRESENT STATUS OF THE IMPORTED PREDATORS

In a recent communication Harry S. Smith, of the Citrus Experiment Station, Riverside, Calif., stated:

"*Cryptognatha nodiceps* and *Azya trinitatis* reproduced on red scale (*Chrysomphalus aurantii*) infesting squash, but not in abundance. We did not succeed in propagating the other species. On June 17, 1936, 110 *Cryptognatha* and two *Azya* were colonized at Santa Barbara on red scale. In May a breeding stock of both species was supplied to the Orange County Insectary. A considerable increase in the stock was obtained there, and several hundred adults were liberated in scale-infested groves. However, we have not

yet observed propagation in the field. The species are still being propagated by the Orange County Insectary but it appears that our red scale is not a particularly favorable host for these beetles."

The *Azya* mentioned in Professor Smith's letter is the *Pentilia castanea* of the specialists of the Bureau of Entomology and Plant Quarantine.

To date we have no further information concerning developments in Florida.

No entomological explorer in foreign countries could wish for greater gratification than that experienced by the writer upon his return to Puerto Rico at the termination of investigations in Peru. On June 30, in company with K. A. Bartlett, of the Bureau of Entomology and Plant Quarantine, who received the shipments and made the original liberations of the predators, the writer collected the progeny of the two dominant species (*Cryptognatha nodiceps* and *Pentilia castanea*) which he had sent from Trinidad only five months earlier, for the purpose of further colonizations. Not only were these two species already well established in their new home, but they had multiplied so rapidly that it was possible to collect 332 adults in less than two hours. The feeling of satisfaction was heightened when, on July 16, the morning of his departure for Washington, the writer, again with Dr. Bartlett, found these two species 3 miles from the center of the original colony. The dispersion was in an easterly direction, towards the largest of the coconut groves on the island. Unfortunately, time was not available to continue the survey to determine the exact limits of dispersion.

Specimens collected in Puerto Rico and submitted to the experts of the Bureau for identification indicate the establishment of at least two other species of coccinellids sent from Trinidad in addition to those named.

One of the advantages of biological control work in tropical countries is that results become quickly known. In temperate regions the establishment of beneficial insects may remain in doubt for several years, sometimes a decade or more. On the other hand, in the Tropics, where shorter life cycles and continuous breeding are the rule, the success or failure of attempts at biological control by introduced species may be determined in a comparativly short time.

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MELVILLE T. COOK, Editor

A BIBLIOGRAPHY OF MYCOLOGY AND PHYTOPATHOLOGY OF CENTRAL AND SOUTH AMERICA, MEXICO AND THE WEST INDIES

By

José I. Otero,

and

Melville T. Cook,

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A BIBLIOGRAPHY OF MYCOLOGY AND PHYTOPATHOLOGY OF CENTRAL AND SOUTH AMERICA, MEXICO AND THE WEST INDIES

By JOSÉ I. OTERO, *Librarian* and MELVILLE T. COOK, *Plant Pathologist*

We present this compilation in the hope that it may be useful to students and research workers not only in these countries but also in other countries.

This bibliography was started independently by the co-authors, one forced by the everyday needs of references to the tropical American literature in connection with his work in plant pathology; the other in his bibliographical work in the library. Since both were interested in the same work it was decided to make it a joined publication which would be of service to the greatest number of workers.

Accordingly a project was drawn by the senior author and the work started for a strictly mycological publication. However, the publications on mycology are so intimately related with plant pathology that it was very soon decided to include both subjects. Therefore, this work may be said to have started when the junior author came to Puerto Rico in 1923 but was definitely organized in its present form in 1930.

It was originally intended by the senior author to append this bibliography to a Host Plant Index to the Fungi of the West Indies, Mexico and Central and South America now in progress but this plan was abandoned and it is presented to the workers in mycology and plant pathology in its present form.

The work on the Host Plant Index demonstrated the great difficulty in collecting data in mycology from the literature covered by this publication. The literature from these parts of the world is not restricted to these countries but many papers have been published in Europe and North America, and in several languages.

The compilers intend to follow as closely as possible the following features in this bibliography, with the idea of making it most helpful to students and workers:

(*a*) It is arranged alphabetically by authors and cronologically under the name of each author, taking always the senior author as guide in cases of more than one.

(*b*) When it has been possible we have used the author's full name which enabled us to verify the correctness of many of the citations and avoid confusion and errors in authorship.

(*c*) Most titles appear first in the original language with translations into English in parenthesis. In some cases it has not been possible to obtain the original paper and in those cases the translated titles appear in parenthesis. Some titles appear only in the original language.

(*d*) When an article appears in more than one publication all except the first paper appear in parenthesis.

(*e*) We have not been able to see all the original papers; therefore there are many which we have been unable to annotate.

(*f*) Many taxonomic, most of the mycological papers and many of the popular papers which do not include any record of a disease or a fungus have not been annotated.

In some cases, the titles of the papers do not indicate the character or the value of the contents. These papers have been inserted with the proper explanatory data.

The authors fully appreciate that some of the literature has not been found and that there may be some errors in this publication. Therefore, we will be pleased to have the workers send us corrections and additions for use in a supplement.

A. K. B. Mycological Notes. Trop. Agric. (Trinidad) **6**(11) : 317. 1929.

Refers to a paper by S. F. Ashby on "Lime and sugar-cane diseases in the West Indies" in Bull. of Misc. Inf. Royal Bot. Garden. Kew, No. 7. 1929.

Refers to *Sphaerostilbe repens, Fusarium* sp., *Phomopsis* sp., and *Botryodiplodia theobromae* all of which are saprophytic and sometimes weak parasites on the lime. Also to *Gloeosporium limetticolum* which is serious in Dominica and St. Lucia. Also to the gumming disease *(Bacterium vascularum)* on cane.

Abbot, E[rnest] V[ictor] & Townsend, C[harles] H[enry] T[yler] El Mosaico de la caña de azúcar y su transmisión. (Sugar Cane Mosaic and its transmission. Est. Exp. Agric. Soc. Nac. Agric. Lima (Perú) Circ. **5**, 10 p., 1928.

Popular discussion of the subject.

———— Plagas fungosas de los vegetales. (Fungous diseases of vegetables). Est. Exp. Agric. Soc. Nac. Agric. Lima (Perú) Informe **4**, 11 p. 1928.

———— La "Roña" y la "mancha" o "hielo" de la papa. (Scab and rot or blight of potato.) Estac. Exper. Agric. Soc. Nac. Agrar., Lima, Perú, Cir. **7**, 11 p. 1928.

Refers to *Spongospora subterranea* and *Phytophthora infestans.*

———— Una nueva enfermedad de la papa (A new disease of potato.) Vida Agric. (Perú) **6**(66) : 181, 1929.

This disease is attributed to *Aecidium cantensis.*

———— Stem rust of wheat in Perú. Phytopathology **19**(11) : 1041–1043, 1929.

A discussion of *Puccinia graminis tritici* with reference to varieties of wheat and methods of distribution.

———— La "Marchitez" del algodón (Wilting of the cotton plant.) Vida Agric. (Perú) **7**(77) : 274–281, 1930.

Attention is called to the annual losses due to this disease.

———— Informe del Jefe de la Sección de fitopatología. Mem. Estac. Exp. Agric. Soc. Nacion. Agrar. (Perú) **2** : 85–101, 1930.

A report of field studies of various diseases. The following fungi are mentioned,—*Puccinia triticinia, Erysiphe graminis* of wheat, *Helminthosporium sativum, H. teres, Ustilago nuda* and *Rhynchosporium secalis.* Recommendations for potato blight control are given.

———— Diseases of economic plants in Perú. Phytopathology **19**(7) : 645–656, 1929.

Reference to mosaic of sugar cane and other plant diseases.

------------, **& Wolcott, G[eorge] N[orton]**

Mosaic of Sugar Cane in Perú. Science **69**(1788) : 381, **1929.**

Account of the occurrence of mosaic disease of sugar cane in Perú and of the abundance of *Aphis maidis* Fitch., its insects vector.

A new host for sugar cane mosaic. Phytopathology **20(1):** 109, 1930.

Refers to our "caña india" known as "caña brava" *(Gynerium saggitatum)*. Growing in or near cane fields becomes infested with mosaic.

Further notes on plant diseases in Perú. Phytopathology **21(11)** 1061–1071, 1931.

Enfermedades de las plantas cultivadas en el Perú. (Diseases of cultivated plants in Perú). Lima Estac. Expt. Agric. La Molina. Circ. **18**, 76 p., 1931. (Bol. Agric. & Ganad. (Perú) No. **1**, 76 p., 1932.)

A powdery mildew on cotton from Perú. (*Erysiphe malachrae*). Mycologia **24**(1) : 4–6, 1932.

Acosta, D. R.

Investigaciones fitopatológicas. (Phytopathological investigations). Min. Indus. Dirc. Agron. (Uruguay) Publ. Mens. **4**: 1–18, 1931.

A list is given of the diseases of the principal crops and other economics and ornamental plants observed in Uruguay.

Agostini, A.

Coconut diseases and beetles. Proc. Agric. Soc. Trinidad and Tobago **13**(11) : 561–566, 1913.

A popular paper in which bud rot and root disease are mentioned.

Alamo Ibarra, Roberto.

El mosaico, matizado o rayas amarillas de la caña de azúcar. (Mosaic, mottling or yellow stripe disease of sugar cane.) Venzuela Min. de Fomento. Panfleto, 55 p., 1927.

Popular discussion of mosaic of sugar cane under Venezuelan conditions.

Alazraqui, J.

Gomosis bacilar y "Court noue", en los viñedos de Mendoza. (Bacterial gummosis and "court noue" on the vines of Mendoza.) Mins. Agric. 1910.

Alfaro, Julio.

A new method of fighting the Propagation of Mosaic disease in sugar cane. Planter & Sugar Manuf. **75**(20): 388–389, 1925. (Sugar **28**(1): 45, 1925. Trop. Agr. (Ceylon) **66**(2): 113–114, 1925. El Mundo Azucarero **13**(5): 150, 1925. Proc. Agric. Soc. Trinidad & Tobago **25**(2): 437–439, 1925.)

Recommends the use of resistant varieties.

Statement of Mosaic control. Proc. Conf. Int. Soc. Sugar Cane Tech. (Havana) **2**: 9199, 1927.

Altson, R[alph] A[bbey]

Plant disease investigations. Brit. Guiana Dept. Sci. & Agric. Ann. Rpt. **1924**: 45–53, 1924.

Brief notes on coffee wilt.

Report on a suspected outbreak of infectious mosaic disease among certain canes in the colony. Journ. Bd. Agr. British Guiana **18**(3): 216–235, 1925. (Int. Sugar Journ. **27**(318): 293, 1925.)

Gives record of losses due to mosaic which is the most serious problem in Jamaica. Considers the case of British Guiana which was supposed to be a case of mosaic but proved to be non-infectious chlorosis.

Report on a visit to Jamaica, Costa Rica and Trinidad, Journ. Board of Agric. British Guiana, **18**(1): 2–19, 1925.

British Guiana, Reports of the Department of Science and Agriculture for the year ending 31st. December 1925, 1926.

This report contains brief reference to root diseases, rind disease (*Melanconium sacchari)*, red spot (*Cercospora vaginae*), *Thielaviopsis paradoxa* and *Stemonitis herbatica* of sugar cane. Also rice blast, witches' broom (*Marasmius perniciosus*) and pod rot (*Phytophthora faberi.)* of cacao, wilt of coconut and *Papulospora* disease of coffee.

Appendix III, Report of the Assistant Botanist and Mycologist. Rept. Dept. of Sci. and Agric. Brit. Guiana for year 1924, p. 45–54, 1926.

Gives a list of important diseases.

The occurrence of *Sclerotium* disease of coffee in the Northwest District. British Guiana Combined Court. **32**: 1–5, 1926.

The author states that there is sufficient evidence to believe that the fungus *Sclerotium coffeicolum* has been in the colony for about 10 or 12 years previous to its first report of damages in British Guiana. He describes the damages caused by this parasitic fungus but has not been able to find an adequate treatment. He recommends spraying with Bordeaux mixture.

Plant disease. British Guiana Dept. Sci. Agr. Rpt. p. 43–45, 1926.

The most outstanding item in this report is the finding of the fungus *Sclerotium coffeioolum* in the coffee groves of the northeastern coffee districts . It is suspecting that it has been in the colony for ten years before being reported.

Plant disease investigations in British Guiana. Brt. Guiana Dept. Sci. & Agric. Ann. Rpt. p. 39–43, 1926.

This report contains among other items, notes on coffee wilt caused by the fungus *Papulospora* (?) sp.

Memorandum on Panama disease. Journ. Board of Agric. British Guiana **20**(2) : 88–90, 1927.

A report on *Fusarium cubense*. Also mentions *Bacterium solanacearum*, *Ustilaginoidella oedipigera*, and *Gloeosporium musarum* on **banana.**

Alvarado, J. Antonio

La gotera en los cafetales (The "Gotera" of the coffee groves). Rev. Cafetera de Colombia **5**(51–53) : 1726–1729, 1933.

A general account of the disease commonly called "gotera". It is caused by the fungus *Stilbella flavida*. The author describes the disease, its nature, damages caused to coffee and general treatment, especially in the nurseries.

Amaral, A[velardo]. Afranio Pompeu

O mosaic. Bol. Agri. (Sao Paulo) Brazil, **27**: 47–156, 1926.

Auchinleck, G. G.

Root disease of cacao in Grenada. Proc. Agri. & Com. Soc. Grenada Appendix II, p., 159–160, 1910.

Anonymous

Notes. Ann. Soc. Entomo. de France. Bul. **11** p. 11, 1842. (Rev. Zool., p. 126–127, 1842.)

Notes on the work of Gueren-Meneville & Perrottet.

Omitted diagnosis. Grevilles **19**: 71–75, 1891.

Taxonomic, includes, *Helotium Venezuelianum* (Klot) Phil., *Phialea furfuripes* (Berk. & Curt.) Phil., *Bulgaria microspora* Berk. **from Venezuela.**

Cane diseases in Pernambuco. The sugar cane, Manchester **26**: 377–379, 1894.

Editorial. The Sugar Cane, Manchester **26**: 505,1894.

A sarcastic statement concerning the work of scientists. No value.

(Plant disease observed in 1894 and 1895.) Relat. Inst. Agron. Sao Paulo, (7–8) : 319–326, 1896.

Among the diseases and pests of the coffee tree mentioned in this report, are a disease of the coffee leaf (*Alternaria* sp.) and a mildew. Other plant disease data is given.

La fugosidad y el pulgón de los cafetales en la República de Méjico. Méjico, Ministerio de Fomento Colonización e Industria 11 p., 1897.

Danger of introducing a Central American coffee in Hawaii. U.S.D.A. Div. Veg. Phy. & Path. Circ. **16**, 1898.

Cacao diseases in Trinidad. Kew. Misc. Bull. **145–146** : 1–6, 1899.

The cacao pod disease. Trinidad Bull. Roy. Bot. Gard. **3**(2) : 183–185, 1899.

The cacao disease in Trinidad. Trinidad Bull. Roy. Bot. Gard. **21** : 221, 1899.

The cacao disease. Trinidad Bot. Dept. Bull. Misc. Inform. **27** : 328, 1901.

The "witch broom" disease on cacao in Surinam. West Indian Bull. **2** : 289–291, 1901.

This refers to a paper by Went in Fijd-schrift voor Plantenziekten for 1900 and shorter papers in Zeitschrift für Pflanzen Krankheiten for 1901 and Journal d' Agriculture Tropicale for 1901. These studies were made in Surinam.

Canker in cacao. Journ. Jamaica Agric. Soc. **7**(11) : 450–451, 1903.

Cacao canker and its eradication. Trop. Agric. (Ceylon) **23** (1) : 31, 1903.

The witches' broom disease of cacao. Agric. News, (Barbados) **2**(26) : 117, 1903.

A bacterial rot of onion. West Indian Bull. **5**(2) : 134–139, 1904.

A discussion of this disease which occurred in Barbados. Name of organism not given.

———— Bud-rot disease of cocoa-nut palm. West Indian Bull. **6**(3): 307–328, 1905.

A general discussion.

———— Witch broom disease of cacao. Agric. News (Barbados) **4**(78): 105, 1905.

———— Pod diseases of cacao. Agric. News (Barbados) **4**(83): 189, 1905.

———— Cacao disease in Surinam. Trop. Life **1**(1): 12, 1905.

———— Cacao diseases. Bull. Dept. Agric. Jamaica. **3**(12): 270, 1905.

———— Field treatment of cane tops for planting purposes. West Indian Bull. **6**(1): 48–52, 1905.

This note refers to an article in West Indian Bulletin 5: 96–103. It gives the results of treatment.

———— Cacao disease II. Bull. Jamaica Dept. Agric. **4**(1): 11–13, 1906.

———— A new disease of cacao. Agric. News (Barbados) **6**(128): 93, 1907.

———— Diseases of coconut palms. Agric. News. **5**(6): 1907.

A brief discussion of root disease. (*Botryodiplodia* sp.), leaf disease (*Pestalozzia* sp.) and bud rot.

———— Root disease of sugar cane. Soc. paper 302, Proc. Agric. Soc. **8**: 101–104, 1908.

Popular discussion of *Marasmius sacchari.*

———— Sugar-cane diseases in Antigua, Agric. News. **7**(158): 155, 1908.

Extract from Report by Stockdale on *Marasmius sacchari.*

———— The principal fungus diseases of cacao. Agric. News. **7**(163): 237, 1908.

Popular note on pink disease (*Corticium lilaco-fuscum*), root disease, brown pod (*Diplodia cacaoicola*) and black pod (*Phytophthora omnivora*).

———— Fungus diseases of cacao. Agric. News **7**(166): 273–274, 1908.

Popular note referring to Stockdale' report in West Indian Bull. 9(2): which was also published in booklet as No. 54 in Pamphlet series of the Department.

----------- The coconut bud-rot in Cuba. Science n. s. **28**(706: 57–58, 1908.

A statement in regard to an appropriation for the study of this disease.

----------- Disease of ground nuts in Dominica. Agric. News, (Barbados) **8**: 315, 1909.

A severe disease which is possibly due to a fungus—*Septogloeum arachidis.*

----------- Eel worms or nematodes. Agric. News (Barbados) **8**: 138, 1909.

Refers to *Heterodera radicola* in Antigua, St. Lucía, St. Vincent and Barbados.

----------- A coffee disease in Dominica. Agric. News (Barbados) **8**(193): 292, 1909.

Brief notes on the fungus *Stilbella flavida* attacking coffee berry. Preventive measures are recommended.

----------- Diseases of ground nuts. Agric. News (Barbados) **3**: 347, 1909.

A species of *Uromyces* was reported from St. Vincent in 1908. A fungus which may be the same was reported from Montserrat in 1907 as *Uredo* sp.

----------- A coffee disease in the new world. Agric. News (Barbados) **8**: 395, 1909.

This note quotes from No. 8 of the current volume of Kew Bulletin in which Massee describes a fungus as *Sphaerostilbe flavida.*

The disease and the fungus are figured on page 411.

----------- Cacao diseases in Surinam. Agric. News (Barbados) **9**: 46, 1910.

This note refers to Bulletins 20 and 21 of the Department of Agriculture of Surinam.

The canker or red disease is described. Mr. A. E. Van Hall finds that the disease caused by a new species of *Spicaria* (*S. colorans*) and that the *Nectria* (probably *N. striatospora*) frequently found on diseased trees is a saprophyte.

This disease in the West Indies is believed to be due to *Nectria theobromae* and *Calonectria flavida.*

Die-back and brown rot appears to be due to *Diplodia cacaoicola.* It was originally believed that the Surinam disease was due to *Chaetodiplodia* but they are the same. *Lasiodiplodia* sp. is also the same.

----------- Trinidad Fungi. Soc. paper 408. Proc. Agric. Soc. Trinidad & Tobago **10**: 87–90, 1910.

This paper gives the following list of fungi: *Hartiella* n.g. *coccinea* Massee. On cocoa pods in Trinidad. *Aphiobolus calathus* Massee

on dead wood in Trinidad *Scleroderris gigaspora* Massee on scale insects (*Mylilaspis citricola*) on orange leaves. *Hendersonia microspora* Massee on fallen orange leaves in Trinidad. *Gloeosporium citri* Massee on fallen orange leaves in Trinidad.

All the above species are described in this paper and in Kew Bulletin No. 1, 1910. *Xylaria pattersonii* Massee, was found in St. Vincent and is described in this same number of Kew Bulletin.

------------ Cacao Canker. Agric. News (Barbados) **9**(214): 222–223, 1910.

------------ Some diseases of rubber trees. Agric. News (Barbados) **9**(219): 302–303, (220): 318, (221): 334–335, 1910.

------------ Two interesting fungi in St. Lucia, Agric. News (Barbados) **9**: 286, 1910.

------------ Additional note on pink disease. Agric. News (Barbados) **9**, 382–383, 1910.

This note refers to the above. It reports *Corticum lilacino-fuscum* on pigeon pea.

------------ Miscellaneous fungi recently examined. Agric. News (Barbados) **9**: 398–399, 1910.

These fungi appear to have been found in St. Vincent. They are *Ustilago sorgii* on Guinea corn (*Andropogon sorghum*, var. *vulgare*.) *Cercospora beticola* on beets and *Uredo vitis* Thümen on grape leaves.

------------ The root disease of sugar cane in Barbados. West Indian Bulletin **10**(4): 347–349, 1910.

A discussion of *Marasmius sacchari*.

------------ The fungus causing pine-apple disease. Agric. News (Barbados) **10**: 126, 1911.

This is a history *Thielaviopsis paradoxa*.

------------ Diseases of Pine-apple. Agric. News (Barbados) **10**: 142, 158, 1911.

Also a discussion of *Thielaviopsis paradoxa*.

------------ Arrow root disease. Agric. News (Barbados) **10**: 174–175, 1911.

Refers to a fungous disease but does not give the name of the fungus.

------------ The die-back fungus of Para rubber and of Cacao. Agric. News (Barbados) **10**: 286, 1911.

This note refers to studies on die back by C. K., Bancroft of Federated Malay States. He says that the fungus *Lasiodiplodia theobromae* should be known as *Thyridaria tarda*.

------------ Cacao-spraying experiment in Grenada. Agric. News (Barbados) **10**: 308, 1911.

Gives methods and results.

------------ Observations on root disease in the West Indies. Part I. Agric. News (Barbados) **10**: 366, 1911. Part II. Agric. News (Barbados) **10**: 382, 1911.

General.

------------ Eel-worms or nematodes. *Heterodera radicicola* (Greef) Mull. Agric. News (Barbados) **11**: 138, 154, 1912.

------------ A report on fungus diseases during the years 1910 and 1911. Agric. News (Barbados) **11**: 30–31, 1912.

Refers to *Melanconium sacchari* on cane in St Vincent; *Colletotrichum gossypii* on cotton in St. Vincent; *Phytophthora faberi* on cacao in St. Lucía; *Rosellinia* sp. and *Sphaerostilbe* sp. on limes in Dominica; *Fomes lucidus* on cacao in Montserrat and Antigua; *Cercospora personata* on ground nuts in Nevis; *Uredo arachidis* on groundnut in Dominica, Montserrat and St. Kitts.

------------ Plant diseases and pests, etc. West Indian Bulletin **12**(2): 175–185, 1912.

This paper contains some records of entomogenous fungi, of red rot (*Colletotrichum falcatum*) in Antigua and of bacterial boll rot of cotton in St Vincent.

------------ Immortal canker. Agric. News (Barbados) **11**: 74, 1912.

A disease of immortel (*Erythrina umbrosa*) is reported in St. Lucia. May be same as disease in Ceylon caused by *Phytophthora faberi.*

------------ Rose mildew. Agric. News (Brabados) **11**: 174, 1912.

Scientific name not given. Method of control given.

------------ Three fruit diseases and and their control. Agric. News (Barbados) **11**: 334–335, 1912.

This note refers to (1) a disease of the mango caused by *Gloeosporium mangiferae;* (2) a disease of Avocado caused by *Colletotrichum gloeosporioides,* and a disease of bread fruit described by Stockdale in Journ. Board of Agric. British Guiana 6: 14.

Coconut diseases in tobacco. Agric. News (Barbados) **11**: 398–399, 1912.

This note refers to a root disease. Cause not given.

A disease of tanias. Agric. News (Barbados) **12**: 30, 1913.

This disease is caused by a fungus described by Ashby as *Hosmrisoium colaoasiae.*

A root disease of *Paspalum dilatatum.* Agric. News (Barbados) **12**: 94, 1913.

This disease is reported in the Report of the Botanical Station, Montserrat. 1910–15: 15. It is similar to the disease of sugar cane caused by *Marasmius sacchari.*

Red rot fungus and sugar cane in the West Indies. Agric. News (Barbados) **12**: 126, 127, 142, 143, 158, 159, 1918.

Historical.

New Exotic Fungi. Agric. News (Barbados) **12**: 206, 1913.

This note refers to Kew Bulletin No. 3, 1913, in which a fungus collected by South of St. Vincent is mentioned. It is *Gloeosporium cocophilum* Wakefield and was found on petiole of coconut palm (*Cocus nucifera*).

Recent French work on diseases of Hevea and cacao. Agric. News (Barbados) **12**: 270, 1913.

This note refers to *Dothidella ulci* on leaves of Hevea, in Brazil.

Witch broom disease of cacao. Agric. News (Barbados) **12**: 302, 303, 1913.

This note refers to a paper of Rorer just issued by the Board of Agric. of Trinidad and Tobago in which he says that the disease is caused by a Basidiomycetous fungus and not by *Colletotrichum luxificum.* This is followed by some good historical data.

Contamination of soil by the toxic products of parasitic fungi. Agric. News (Barbados) **12**: 334, 1913.

This note refers to an article in Monthly Bulletin of Agricultural Inteligence and Plant Diseases (April, 1913.)

Black spot of rose leaves. Agric. News (Barbados) **13**: 14, 1914.

Popular. Cause not given.

Fomes semitostus in British Guiana. **13**: 14, 1914.

This note refers to a note by C. K. Bancroft in Journ. Board of Agric. for British Guiana. Oct. 1913. This fungus occurs on stumps of unknown trees.

Mycological notes. Witch broom disease of cacao. Dept. Agric. Trinidad and Tobago, Bulletin **13**(84) : 323, 1914.

A note attributing the disease to *Colletotrichum luxificum.*

Leaf-cut or tomosis, a disorder of cotton seedlings. Agric. News (Barbados) **13** : 126, 1914.

Refers to a disease on St. Croix which resembles the disease described by O. F. Cook.

A parasite on coffee. Agric. News (Barbados) **13** : 141, 1914.

This note quotes from Monthly Bulletin of Agricultural Intelligence and Plant Diseases (Jan., 1914) as follows: "*Stilbum flavidum,* Cooke, is well known throughout tropical and sub-tropical America as the cause of roundish dry spots on the leaves of coffee. The writers have recently studied this fungus in the neighborhood of Río de Janeiro on coffee and other plants. (*Eriobotrya japonica* and various Melastomaceae, Compositae and Rubiaceae). There is little doubt that *S. flavidum* occurs naturally in the forests on various shrubs. This origin explains the local distribution of the fungus which in Brazil occurs chiefly in the coastal regions, where it finds the heat and moisture necessary for its development."

"All attempts at further classification had been unsuccessful owing to the sterility of the fungus. In moist chamber the writer has at least obtained fructifications of a typical Agric. the character of which refers it to the genus *Omphalia;* it apparently constitutes a new species (*O. flavida*)."

Fungoid disease in Barbados. 1912–13. Agric. New (Barbados) **13** : 158, 1914.

This note refers to the Ann. Report of the Barbados Dept. of Agric. for the year ending March 31, 1913. It records *Marasimus sacchari* and *Colletotrichum falcatum* on sugar cane; *Eutypa erumpens* on *Ficus nitida, Coniothecium* sp. on limes; *Actinonema rosae* Probably same as *Diaoccum* (*Marssonia*) *rosea* and *Sphaerotheca pannosa* on roses; and *Uncinula spiralis* on the vine.

Two tomato diseases. Agric. News (Barbados) **13** : 174,1914.

Two diseases in Barbados on tomatos grown from American seed. Leaf mould (*Cladosporium fulvum* Cke) and blossom end rot.

Base root of pine-apples. Agric. News (Barbados) **13** : 190, 1914.

Disease found in St. Kitts is due to *Thielaviopsis paradoxa* Went.

Black root disease of limes. Agric. News (Barbados) **13** : 346, 1914.

A report on a disease in Dominica caused by *Rosellinia bunodes.* Also a description of the disease.

Wilt disease of leguminous plants. Agric. News (Barbados) **13**: 348, 1914.

A disease of *Tephrosia candida* in Montserrat; said to be due to *Neocosmospora vasinfecta* E. F. S.

Molestia do afeeiro (Coffee diseases) Bol. Agric. Sec. Agric. Com. & Obras, S. Paulo (Brazil) **16**(1): 69–75, 1915.

Detailed discussion on the fungus, *Stilbella flavida* (Cooke) Lind., giving description, distribution and damages caused by it.

Plant diseases and pests. Trinidad & Tobago Dept. Agric. Bull. **14**(2): 62, 1915.

Cacao thrips and die-back in St. Vincent. Agric. News (Barbados) **15**(369): 206–207, (370): 222–223, 1915.

The cause of the witch-broom in Cacao. Journ. Bd. Agric. British Guiana. **9**: 1–3, 1915.

This disease reported by Ritzema Bos due to *Exoascus theobromae;* Howard found spores of *Fusarium* and suspected *Nectria* sp.; Charles suspected *Lasiodiplodia;* van Hall and Drost said it was due to *Colletotrichum luxificum.* Recently Stahl said it was due to *Marasmus perniciosus.*

Rusts and smuts of indian corn. Agric. News (Barbados) **14**: 78, 1915.

This note refers to these diseases but the only one definitely recorded is *Ustilago Zea* (Beck.) Ung., which the author reports as widely distributed throughout the West Indies.

Preliminary note on a disease of *Carica papaya.* Agric. News (Barbados) **14**: 174, 1915.

A stem disease that may be due to *Colletotrichum* sp.

Diseases of cassava in Trinidad. Agric. News (Barbados) **14**: 174, 1915.

This paper refers to *Cercospora* sp., *Gloeosporium manihot* and *Bacillus Manihotus* as occuring in some tropical countries but does not made a definite statement in regard to locality. However, he does say that the *Rosellinia* root rot occurs on both cassava and cacao in the Lesser Antilles.

A new form of black root disease of cacao. Agric. News (Barbados) **14**: 254, 255, 1915.

An extract from report by Wm. Nowell to the Imperial Department of Agriculture. The disease is reported in wet districts of Grenada, St. Lucía and Dominica and is said to originate in stumps of *Piptadenia peregrina.*

The entomogenous fungi of Porto Rico. Agric. News (Barbados) **14**: 286, 1915.

Refers to a report of J. R. Johnston.

Die-back of lime trees in Montserrat. Agric. News (Barbados) **14**: 318, 319, 1915.

Extract from a report made to the Imperial Commissioner of Agriculture. The disease resembles that caused by *Colletotrichum gloeosporioides.*

The internal disease of cotton bolls. Agric. News (Barbados) **14**: 222, 238, 239, 1915.

This disease is reported from Montserrat, Antigua, St. Vincent and Tortola. It is attributed to *Bacterium malvacearum.*

Spraying of ground nuts for leaf rust. Agric. News (Barbados) **14**: 350, 1915.

The disease is caused by *Uredo arachidis* Lag., and is reported from Montserrat.

Some new entomogenous fungi in St. Vincent. **15**: 110, 1916.

An indefinite report on some fungi and a definite report of fungus resembling *Septobasidium pedicullatum* Schiven on *Aulacaspis pentagona* in St. Lucia. He also reports *Ophironectria coccicola* E. & E.

Marasmius perniciosus n. sp. cause of witch broom on the cacao-tree in Surinam. Int. Rev. Sci. & Pract. Agric. **7**(1): 158–159, 1916.

Pineapple wilt. Agric. News **15**: 174, 175, 1916. (West Indian Bull. **8**: 158–161, 1916).

A new cane disease in Puerto Rico. Report Bd. Commissioner Agr. **1914–15**: 270, 1916.

This note refers to *Cytospora sacchari.*

Rosellinia root diseases in the Lesser Antilles. Agric. News (Barbados) **15**: 382, 1916.

This note is an extract from a paper by Wm. Nowell in West Indian Bulletin 16(1). He says that *Rosellinia* disease occurs in Guadaloupe, Dominica, Martinique, St. Lucia, St. Vincent and Grenada. It occurs on cacao on all these islands, on coffee in Guadeloupe and Martinique; on limes in new clearings in Dominica and on arrow root in the interior of St. Vincent. The disease on cacao is caused by *R. pepo;* the disease on limes and coffee by *R. pepo* and *R. bunodes.*

Affections of lime seedlings. Agric. News (Barbados) **15**: 414, 1916.

A damping off disease in Montserrat caused by one of the downy mildews (*Peronosporaceae*).

The fungus on cacao thrips. Agric. News (Barbados) **15**: 430, 1916.

Reports a fungus (*Sporotrichum globuliferum* on cacao thrips *Heliothrips mbrociveta*) in St. Vincent. This fungus was first described by Spegazzini on material on bodies of dead beetles in Argentina.

Report on the prevalence of some pests and diseases in the West Indies during 1915. Compiled from Reports of the principal local Agricultural Officers. West Indian Bull. (Barbados) **16**(1): 1–30; 309–331. 1916.

A collar disease of pigeon peas. Agric. News (Barbados) **16**: 78, 1917.

This is a report of a disease of *Cajanus indicus* in Granada. Cause not given.

Preliminary trials with the cacao thrips. Agric. News **16**: 94, 1917.

This note refers to a note in Agricultural News 15:430. The fungus is *Sporotrichum globuliferum.* It was sprayed on plants in plots in the Botanic Garden but the weather was dry and only one insect was found to be parasitized. When sprayed on plants in boxes so as to retain a high humidity many insects were parasitized. The green muscardine fungus *Metarluzium anisopliae* was used in boxes with same result.

Internal disease of cotton bolls in the West Indies. Agric. News (Barbados) **16**: 318, 1917.

This note refers to a paper by Nowell in West Indian Bulletin, Vol. 16(3) Sept. 10, 1917. This disease appear to due to a fungus *Eremothecium cymbalonia* or to bacteria which gains entrance through injuries by *Dysdescus* spp. and *Nezara vividula.*

Plant diseases. Agric. News **16**: 331, 332, 350, 1917.

This note refers to a report by Nowell in Dominica. Official Gazette, Aug. 27, 1917, in which the author reports *Nectria* and *Stilbum* spp.

Plant diseases in Barbados in 1917. Agricultural News (Barbados) **17**: 78, 1918.

This note refers to the Annual Report of the Barbados Dept. of Agric. (issued as a Supplement to the Official Gazette, Jan. 24, 1818). It recorded *Marasmius sacchari, Colletotrichum falcatum. Cercospora vaginae,* and *Cephalosporium sacchari* on sugar cane.

Internal disease of cotton bolls in the West Indies. Agric. News (Barbados) **17**: 238, 1918.

A discussion.

Citrus diseases in Cuba. Agric. News (Barbados) **16**: 142, 1919.

This note refers to California Bulletin by H. S. Fawcett and reported the following diseases in Cuba: *Mal di gomma* or foot rot, psorosis, or California scaly bark, Diplodia gummosi due to *Diplodia natalensis,* a gum disease of lemon trees different from *Pythiacystis* or *Botrytis* gummosis in California or foot rot in Florida. The most serious gummosis in Cuba appears to be due to *Pythiacystis* probably *P. Citrophthora.* Other diseases were scab due to *Cladosporium citri,* wither tip of limes due to *Gloeosporium limetticolum,* blossom end rot of Persian limes, Diplodia rot (*Diplodia natalensis*), leaf spot due to *Mycoidea parasitica,* black melanose or greasy spot.

Plant diseases in Jamaica. Agric. News (Barbados) **18**: 30, 1919.

This note refers to Ashby's report for Dept. of Agric. of Jamaica, March 31, 1918. The diseases referred to are the Panama disease of banana in which are found a Fusaria similar to *F. vasinfectum* and *F. radicicola;* bud rot of coconut in which he found a fungus (probably *Pythium palmivorum*); leaf bitten or bite of coconut; apparently a species of *Albugo* on sweet potato, apparently *Rostrella coffeae* on pimento although coffee in the same field was not diseased; *Corticium vagum* var, *solani* on yams; *Phytophthora infestans* on potato; honey comb disease of copra caused by *Bacillus mesentericus vulgatus; Aschersonia aleyroidis, Aegerita weberri* and *Verticillium heterocladium* on insects.

Disposiciones vigentes sobre el servicio de sanidad vegetal. (Regulation in force relating to the sanitation service.) Ofic. Sanidad Veg. Sec. Agr. Com. & Trab. (Cuba) 32 p., 1919.

Quarantine regulations.

Plant legislation in Dominica. Agric. News (Barbados) **18**: 292, 1919.

Quarantine regulations.

Degeneración de la papa y manera de evitarla. (Degeneration of the potato and means of preventing it.) Rev. Agr. (México) **4**: 415–421, 1919.

The author attributes the disease to *Phytophthora infestans* and other fungi.

Plant legislation in Dominica. Agric. News (Barbados) **18**: 237, 1919.

Quarantine regulations.

Report on the prevalence of some pests and diseases in the West Indies during 1919. West Indian Bull. **19**(1): 18–37, 1919.

Important records.

The mottling disease of sugar cane. Agric. News (Barbados) **18**: 62, 63, 1919.

This note is a discussion of earlier circular 14.

Chlorosis of sugar cane. Agric. News (Barbados) **18**: 68, 69, 1919.

This note refers to an article by Tempany in West Indian Bull. 16: 137 in regard to areas of chlorotic cane in Antigua. They appear to be due to excessive calcium carbonate. The note refers to similar conditions in cane fields of Puerto Rico and in pine-apple field of Hawaii.

Recent plant legislation in Granada. Agric. News (Barbados) **18**: 169. 1919.

Quarantine regulations.

Report on the prevalence of some pests and diseases in the West Indies during 1920. West Indian Bull. **19**(1): 237–271, 1920.

Important records.

Mosaic or mottling disease of sugar cane. Agric. News (Barbados) **19**: 345, 1920.

Popular.

Mosaic disease of canes. Journ. Jamaica Agric. Soc. **24**: 313–314, 1920.

Government regulation for eradication.

El mildiew o blanco de los zapallos. (Cucumber mildew.) Defensa Agric. (Uruguay) **1**(1): 12–13, 1920.

The Bordeaux treatment for Powdery mildew (*Oidium* sp.) of cucumbers.

Cura de las semillas de trigo. (Treatment of seed wheat.) Defensa Agrícola (Uruguay) **1**: 115–119, 1920.

Copper sulphate and formalin treatments.

Enfermedades de las plantas producidas por hongos. (Plant diseases produced by fungi.) Defensa Agric. (Uruguay) **1**: 79–83, 1920.

Popular.

Report on the prevalence of some pests and diseases in the West Indies during 1918. West Indian Bull. **18**: 34–36, 1920.

A list of diseases compiled from reports from the colonies under Imperial Department of Agriculture.

Porto Rico fights cane mottling disease. Sugar **22**: 208–210, 1920.

A review of recent publication in Puerto Rico.

Plaga blanca de las cebollas. (White disease of onions.) Rev. Agric. (México) **5**: 601–602, 1920.

The disease is caused by a *Fusarium* sp.

The watery or monilia disease of cacao pods. Agric. News (Barbados) **19**(470): 142, 143, 1920.

This disease is reported from Ecuador in a handbook by Rorer in 1918. It is believed to be indigenous to that country. It is described in this note.

Black spot and dark rot of cacao. Agric. News (Barbados) **19**: 206, 1920.

This note is based on Rorer's hand book. The disease has not been reported from any country other than Ecuador. It is a wound parasite caused by *Sphaeronema* sp. The disease and the fungus are described and preventive measure recommended.

Investigation of the froghopper pest and disease of sugar cane. Agric. News (Barbados) **18**: 174–175, 190–191, 222–223, 1919.

This note includes a discussion of root diseases which the author says are divided in two groups. Group I is *Marasmius sacchari;* group II is *Odontia sacchari, O. saccharicola* and *Himantia stollifera.* The author also discusses the factor influencing these diseases.

Mosaic or mottling diseases. Agric. News (Barbados) **19**: 245, 1920.

Red ring disease of coconuts. Agric. News (Barbados) **18:** 398, 1919.

This note is an extract from Nowell's report in Trinidad. Oct. 16, 1919. The disease is caused by nematodes.

Root rot disease of cacao. Jamaica Agric. Soc. Journ. **24:** 173–174, 1920.

A note on the mosaic disease of sugar cane. Agric. News **19:** 366, 1920.

A discussion which refers to Stevenson article in Journ. Dept. Agric. Porto Rico. July 19, 1920.

A new method of selecting cane free of the mosaic disease for planting. Agric. News (Barbados) **19:** 363, 1920.

A note based on Edgerton's paper in La. Planter & Sugar Mfg. Oct. 1920.

Control of nematodes. Agric. News (Barbados) 9: 367, 1920.

This note refers to a paper by Cobb in Science, June 1920 and suggests the introduction of promising species of monochs.

Mosaic disease of sugar cane. Agric. News (Barbados) **9:** 222, 1920.

This note refers to a paper by Brandes in Journ. Agric. Res. May 1, 1920.

The Panama disease of banana. Agric. News (Barbados) **19:** 62, 94, 1920.

A discussion of paper by Brandes in Phytopathology. Sept. 1919.

Mosaic disease of sugar cane. Agric. News (Barbados) **19:** 158, 1920.

Refers to the Report of the Commissioner of Agriculture and Labor of Puerto Rico, 1919.

Mosaic disease of sugar-cane in Trinidad. Agric. News (Barbados) **19:** 126, 1920.

A report of the disease in Trinidad. Had been there at least two years.

The wither-tip of limes. Journ. Bd. Agric. British Guiana. **13:** 24, 25, 1920.

The disease is caused by *Gloeosporium limetticolum.*

Diseases of economic plants. West Indian Bulletin **18**: 50–60, 1920.

Records and geographical distribution in the West Indies.

Mosaic diseases—susceptible and immune varieties. Journ. Jamaica Agric. Soc. **25**: 427–429, 1921.

The mosaic disease of sugar cane in Trinidad. Int. Sug. Journ. **23**: 74–75, 1921.

Coffee Diseases. Bull. Agric. Com. & Obras Pub. (S. Paulo) **22**: 330–332, 1921.

Diseases of Liberian coffee in Surinam. Agr. News (Barbados) **20**: 126, 1921.

Molestias em caffezaes (Diseases in coffee groves) Bul. Agr. S. Paulo. **22**(12): 330–332, 1921.

Report of a disease found on coffee in the district of Piratininga (Brazil). It was found associated with the fungi; *Alternaria tenuis*, *Phoma* sp. and *Fusarium* sp.

Diseases of economic plants. West Indian Bull. **19**: 31–37, 257, 271, 1921.

List of diseases and geographical distribution.

Mosaic disease in Barbados. Agric. News (Barbados) **20**: 15, 1921.

J. R. Bovell announces first appearance of the disease.

Relation between cacao pod rot and coconut bud rot. Agric. News (Barbados) **20**: 318, 1921.

La siembra del trigo y los tratamientos de la semilla. (Wheat seeding and seed treatment) Defensa Agric. Uruguay) **2**: 89–98, 1921.

Treatment of wheat for bunt—*Tilletia*.

Second rapport de la Station Agronomique de la Guadeloupe, **1919–20**: 21–22, 35–42, 1921.

Reports *Marasmius sacchari* on sugar cane.

Panama disease. Journ. Jamaica Agric. Soc. **26**: 454–456, 1922.

This disease which is due to *Fusarium cubense* first appeared in Panama in 1911.

Cocoe rot. Journ. Jamaica Agric. Soc. **26**(2–3) : 62–54, 1922.

A discussion of the parasitism of *Hormiseium colocasiae*. He quotes a report by Ashby (1912) who gives the name *H. xanthosomae* n. sp. which be later change to *Vasculomyces xanthosomae*.

Report on the Agricultural Department, St. Lucía, 1921. Imper. Dept. Agric. West Indies. 1922.

Includes a report by Ashby on *Fusarium cubense*.

Ecuador Cacao disease. Bull. Pan. American Union **55**: 393, 1922.

Report of a commission of planters. The local name is "escoba de brujas" meaning witches' broom.

Notes on the proclaimed diseases and pests. Bull. Dept. Agric. Trinidad & Tobago. **19**(4) : 175–180, 1922.

Popular. Refers to bud rot of coconut, red ring disease of coconut, *Anthracnose* (blossom-blight and wither-tip) of limes.

Transmission of Sugar-cane mosaic by aphids. West Indian Committee. Circ. **37**: 521, 1922.

Report of the Dept. of Agriculture, Barbados, for the financial year **1921–22**: 19, 1922 (Rev. Appl. Mycol. **2**: 260–261, 1922).

Verslag over het jaar 1922 Department van Landbouw in Suriname. (Report of the Department of Agriculture, Suriname, for the year 1922,) p. 106, 1923.

Sugar and Mosaic disease of canes. Journ. Jamaica Agric. Soc. **27**: 864–869, 1923.

A popular review of the subject.

Mosaic disease in Jamaica. West Indian Committee Circ. **38** (653) : 435–436, 1923.

Argentina: Plant inspection. Bull. Pan-Amer. Union **56**: 385–386, 1923.

An order by the Minister of Agriculture.

La sarna de la papa y manera de combatirla. (Potato scab and its control.) Defensa Agrícola (Uruguay) **4**: 106–108, 1923.

Symptom and control of *Actinomyces scabies*.

Encrespadura del duraznero (Peach leaf curl.) Defensa Agrícola (Uruguay) **4**: 91–93, 1923.

Symptoms and control of *Exoascus deformans*.

Chile: Sanitäre Pfianzenschutzmassnak-men. Gesetz No. 177 vom 31. December 1934. In Auszug. (Chile, Sanitary plant protection measures. Order No. 177 of 31 st. December 1924.)

Quarantine regulations.

Nicaragua: Reported cure for banana disease. Bull. Pan- American Union **58**: 299, 1924.

Banana diseases. Journ. Jamaica Agric. Soc. **28**: 247–248, 1924.

A preliminary report on the prevalence of the Panama disease in Jamaica.

La enfermedad de la hoja del tomate. (Tomato leaf disease.) Defensa Agrícola (Uruguay) **5**: 17–23, 1924.

Symptoms, life history and control of *Septoria Lycopersici*.

Work in connection with insect and fungus pests and their control. Rept. Agric. Dept. (Antigua), **1922–23**: 7–8, 1924.

Report on the Department of Science and Agriculture, British Guiana, for the year 1922, 45 p., 1924.

Reports bud rot of the coconut, witches' broom of the cacao (*Marasmius pernicious*), *Marasmius* sp. of sugar cane, collar rot and knot of citrus and *Colletotrichum falcatum* on *Andropogon sorghum sudanense*.

El cáncer del peral (Pear canker.) Defensa Agrícola (Uruguay) **5**: 25–26, 1924.

Canker caused by *Monilia sp.* Said to be distinct from *Sclerotinia* (*Monilia*) *fructigena*.

Desarrollo de las enfermedades de origen criptogámica en la viña, durante la presente estación. (Development of cryptogamic vine diseases during the present season.) Defensa Agrícola (Uruguay) **5**: 1–13, 1924.

Spraying for the diseases of the grape.

Antracnosis de la vid. (*Gloeosporium ampelophagum* de Bary). Anthracnose of the Vine (*Gloeosporium ampelophagum* de Bary.) Min. Agric. Nac. (Buenos Aires), Sec. Prop. e Inform. Circ. **201**, 4 p., 1924.

A description and recommendations for treatment.

La viruela de los frutales ("Small pox" of fruit trees *Coryneum Beijerinkii* Oud.) Argentina Min. Agric. **341**, 4 p., 1924.

Brief popular account of this disease.

La viruela de los frutales de corozo. ("Small pox" of the trees of stone fruits.) Argentina Mins. Agric. **345**, 8 p., 1924.

La gomosis del naranjo (Gummosis of the orange tree.) Argentina Mins. Agric. **339**, 4 p., 1924.

Brief popular account of this disease.

Regulations against banana disease in Jamaica. Rev. of Appli. Mycol. **3**: 64, 1924.

Dominican Republic. Protection against plant diseases. Bull. Pan-Amer. Union **56**: 1261–1262, 1925.

An official order.

Mosaic disease inspection. Rept. Dept. Agric. (Barbados) **1924–25**: 8, 1925.

Work connected with insect and fungus pests and their control. Rept. Agric. Dept. St. Vincent for the year **1924**: 16–25, 1925.

Mentions *Sclerotium rolfsii, Ovulariopsis gossypii* and *Phytophthora* sp. on cotton. *Marasmius sacchari, Melanconium sacchari, Thielaviopsis paradoxa* on sugar cane. *Puccinia arachidis* on peanuts and *Ustilago Zeae* on corn.

El Dr. Cross y el mosaico de la caña en Cuba. (Dr. Cross and Mosaic disease of sugar cane in Cuba.) Rev. Agric. Com. & Trab. (Cuba) **7**(3): 10–11, 1924.

Controversial.

Experimental Agriculture in Jamaica. Int. Sugar. Journ. **26**: 274–276, 1924.

Verslag over het jaar 1923. Dept. van Landbouw in Suriname, 114 p., 1924.

This report contains information about the sieve tubes (Phloemnecrosis) of coffee trees and probable insects carriers.

The mosaic disease of Sugar cane Order, 1923. Journ. Jamaica Agric. Soc. **28**: 27, 1924.

Mosaic cane disease in América. Australian Sugar Journ. **16**: 420, 1924.

Tratamiento eficaz para combatir la "fumagina" de la manzana "cara sucia". (Successfull treatment to fight "soot" of the apple "cara sucia") Argentina Circ. **468**, 7 p., 1925.

Brief popular account on this subject.

Plant diseases law (Law 10 of 1925). Journ. Jamaica Agric. Soc. **29**(7): 267–280, 1925.

Mosaic disease. Trop. Agric. (Trinidad) **2**: 30, 1925.

A review of Rosenfeld's paper "The beneficial aspect of msoaic disease."

Mosaic disease. Journ. Jamaica Agric. Soc. **29**: 81, 1925.

A brief note containings lists of susceptible hosts.

Mosaic disease inspection, Barbados Dept. Agric. Ann. Rpt. **1924–25**: 8, 1925.

A record of inspection for sugar cane mosaic.

El mosaico en Cuba. (Mosaic disease in Cuba.) Cuba, Rev. Agric. Com. Trab. **7**(8): 23–25, 1925.

Mosaikkrankheit auf Kuba. (Mosaic disease in Cuba.) Deutsche, Zucker-industrie **50**: 1246, 1925.

Work in Connection with insect and fungus pests and their control. Antigua Dept. Agric. Report **1922–23**: 7–8, 1924. (Rev. Appl. Mycol. **4**: 59–60, 1925.)

Research on diseases of plants (mosaic) Trop. Agric. (Trinidad) **2**: 200, 1925.

Mosaic disease of sugar cane. Journ. Jamaica Agric. Soc. **29**: 144, 1925.

Enfermedad del mosaico. Extracto del Informe de la Comisión de Matanzas. (Mosaic disease. Summary of the Matanzas Commission Report.) Rev. Agric. Com. & Trab. Cuba **7**(8): 25–27, 1925.

Mosaic disease. Jamaica Dept. Agric. Ann. Rpt. 1925.

Work in connection with insect and fungus pests and their control. Report Agric. Dept. St. Kitts–Nevis **1923–24**: 5, 33, 1925. (Rev. Appl. Mycol. **4**(11): 704, 1926.)

La enfermedad de la raíz del café en los semilleros. (Reproducción de la Hacienda, Venezuela.) (Coffee root disease in the seed beds.) Rev. Agric. Puerto Rico. **17**(2): 18, 1926.

Mosaic disease in Jamaica. Sugar **28**(1): 30, 1926.

A review of circular issued by the Department of Agriculture of Jamaica.

Mosaic da canna de assucar. (Sugar-cane mosaic) Min. Agric. Indus. Com. Inst. Biol. Defensa Agric. Río de Janeiro (Brazil) Circ. Serv. Phytp. 11 p., 1926.

Results of cane selection in Porto Rico. (Introduction of improved varieties credited with increasing annual value of crop by $13,000,000.) Facts About Sugar **21**(40): 950, 1926.

Popular.

Verrugas de la vid. (Vine wart.) Argentina Mins. Agric. Circ. **484**, 4 p., 1925.

Brief account of a bacterial disease; preventivo and curativo measures are given.

La verruga de la viña. (Crown gall of the vine.) Min. Agric. Nac. (Buenos Aires). Sec. Prop. e Inform. Circ. **565**(3): 1, 1926.

The causal organism in *Bacterium tumefaciens.*

The protection from plant disease (Banana trash) order 1926. Journ. Jamaica Agric. Soc. **30**(10): 434–435, 1926.

Annual Report of the Jamaica Department of Agriculture for the year ending Dec. 31, 1926. 29 p., 1926.

Fusarium cubense is mentioned.

Work connected with insect and fungus pests and their control. Rept. Agric. Dept. St. Vincent (West Indies) for the year **1925**: 13–18, 1926.

Contains records of several common diseases.

Mycological work. Rept. of Agric. Barbados, **1925–26**: 10, 1926.

A report on *Sclerotium rolfsii* causing a wilting of artichoke.

Brazil: Legislative and administrative measures. Internat. Bull. of Plant Protection **1**(1): 11, 1927.

Decreto que prohibe la entrada de la papa extranjera atacada por plagas (Decree prohibiting the entry from abroad of potatoes atacked by pests and diseases.) Bol. Mins. Offic. Def. Agr. Estados Unidos Mexicanos **1**(2): 66–69, 1927.

Foreign Quarantine No. 7. Bol. Mens. Ofic. Def. Agric. Estados Unidos Mexicanos **1**(7): 536–537, 1927.

A quarantine regulation.

Algunas plagas de los frutales. (Some pests of fruit trees.) Argentine, Mins. Agric. No. **721**, 14 p., 1927.

Brief notes on some fruit-tree diseases giving formulas for spraying.

La production du cacao d l' Ecuateur. (*Marasmius perniciosus*) (Cacao production in Ecuador) Agron. Colon. **16**: 173–174, 1927.

Algunas plagas de las hortalizas: (Some pests of the vegetable garden.) Argentina Mins. Agric. No. **720**, 8 p., 1927.

Brief notes on some vegetable garden diseases giving formulas for spraying.

The selection of sugar-cane varieties for planting purposes. Planter and Sugar Manuf. **81**(13): 246–247, 1928.

This note is based on a paper by Earle in the 1928 Reference Book of the Sugar Industry of the World. Contains brief reference to diseases.

Hexenbesenkrankheit in Trinidad. (Witchs' broom disease in Trinidad.) Tropenpflanzer **31**: 416–417, 1928.

Discussion on witch broom disease. Proc. Agric. Soc. Trinidad & Tobago. **28**: 318–320, 1928.

Enfermedad de las naranjas. (Diseases of oranges). Bol. Agric. Indust. & Com. (Guatemala) **4**(5): 159–160, 1928.

Refers to gummosis.

Ground nut rosette disease. Trop. Agric. (Trinidad) **6**: **111**, 1929.

Quoted from Nature 122: 938, 1929.

Cacao notes. The relation between diseased cushions and the seasonal outbreak of black pod disease of cacao. Trop. Agric. (Trinidad) **6**: 295, 1929.

Informe de las actividades de la oficina general para la defensa agrícola. (Report on the work of the Federal Office for Agricultural defense.) Bol. Mens. Offic. Def. Agric. México **3**: 237–239, 457–483, 1929.

Plagas y enfermedades de las plantas de cultivo interceptadas por el Servicio de Sanidad de los Estados Unidos durante el año de 1928, procedentes de México. (Diseases and pests of cultivated plants reported from México by the United States Quarantine Service during the year 1928.) Bol. Mens. Off. Def. Agric. (México) **3**: 439–443 1929.

Gummosis in Barbados. Trop. Agric. (Trinidad) **6**(12): 340. 1929.

A note stating that Dr. Briton-Jones has recently found this disease of cane (*Bacterium vascularum*) in Barbados.

O'mal da Panamá nos bananaes do Ecuador, Conselyos para debellar o' mal da Panamá. (The Panamá disease in the banana plantations of Ecuador. Recommendations for the control of the Panamá disease.) Bol. de Agric. Sao Paulo, Ser. **30a**, (3–4): 278–281, 1929.

This paper refers to *Fusarium cubense*.

Legislative and Administrative Measures. Argentina. Internat. Bull. of Plant Protect. **3**(4): 56, 1929.

Witchs' broom control 1929. Progress report (December).— Proc. Agric. Soc. Trinidad & Tobago, **30**(1): 15–16, 1930.

Attributes the disease to *Marasmius pernicosus*.

The Panama disease of bananas Amendment Order 1931, Under Section 3 of the Protection from Diseases (Plants) Law 1925, Law 10 of 1925, Dept. of Sci. and Agric. Jamaica 2 p., 1931.

Panama disease. Also Bonnygate (*Sphaerostilbe musarum*), black spot (*Cescospora musarum*) and *Marasmius*.

Mycological notes. Trop. Agric. (Trinidad) **7**(11): 309, 1930.

This note refers to a paper by J. Eaton and R. G. Fullerton on the effect of damp storage of a raw rubber. The author isolated three species of *Penicillum* (one of which was probably *P. luteum*), four species of *Aspergillus* (probably *A. orchraccus*, *A. temeus*, *A. higer* and *A. versicolor*) and a black *Torula*.

La "mancha de hierro" del cafeto. (The "iron stain" of the coffee trees.) Rev. Cafetera de Colombia **3**(28–29): 1065–1068, 1931.

Popular article reproduced from "La Hacienda". This is the answer to an inquire made to the Experiment Station, Río Piedras, P. R. The disease described is caused by the fungus *Stilbella flavida*. The author gives as additional host plants of the fungus the following: oranges, mango, begonia, several ferns, *Commelina* sp., *Inga Inga* and *Cissus sicyoides*.

Principales plagas y enfermedades de los cultivos en la República Mexicana incluyendo las más importantes de los Estados Unidos de Norte América. (Principal diseases and pests of cultivated crops in the Mexican Republic including the most important of United States of North America.) Tacubaya, D. F. Sec. Agric. & Fomento, México 378 p., 1931.

Work connected with fungus and insect pests and their control. St. Kitts-Nevis, Dept. Agric. Rpt. **1931**: 6, 1932.

Work connected with fungus and insect pest and their control. Tomatoes. St. Vincent Dept. Agric. Ann. Rpt. **1931**: 9–10, 1932.

El mal de Panamá. Enfermedad vascular de la planta del plátano. (Panamá disease. Vascular disease of the banana plant.) Sec. de Agric. y Fomento. Oficina para la defensaAgr. Boletín de Divulgación Núm. **15**, Estados Unidos Mexicanos, (México), 1932.

A very complete discussion with methods of control and legislation.

Administration Report of the Director of Agriculture, Trinidad and Tobago for the year 1932, 58 p., 1933.

A lengthy discussion of the witchs' broom of cacao caused by *Marasmius perniciosus* and a reference to *Gloeosporium limetticolum* on limes.

Varietal introduction in Puerto Rico and Philippines. Intern. Sugar Journ. **35**(415): 257–258, 1933.

Brief review of a lecture by C. E. Chardón and a paper by J. J. Mirasol on the effect of the introduction of immune or resistant sugar cane varieties to mosaic disease in Puerto Rico and the Philippine Islands respectively.

Desmusgue. Rev. Cafetera de Colombia. **5**(48–50): 1675, 1933.

The Panama disease amendment Order 1934, Journ. Jamaica Agric. Soc. **38**(9): 573, 1934.

Legislation.

Report on the Agricultural Department, St. Kitts-Nevis, for the year ended 31st. December, 1933. Trinidad, Imper. Comm. Agric., West Indies, 49 p., 1934.

In this report (page 38) information is given as to the present situation regarding gumming disease of sugar cane, which is present in most of the cane fields. No mosaic disease has been reported so far.

The Panama disease of bananas. Amendment Order **1934.** Journ. Jamaica Agric. Soc. **38**(9): 573, 1934.

Report on diseases and pests for the months of May and June, 1934. Proc. Agric. Soc. Trinidad and Tobago, **35**(7): **283–**284, 1934.

Brief note on witch's broom disease of cacao.

Enfermedades más comunes de las plantas cultivadas. (Prevalent diseases of cultivated plants). Min. Hacienda. Entre Ríos, Argentina, Dept. Agric. Gan: Bull. 7 p., 1935.

Popular account on some well-known fungal and bacterial diseases in Argentina. Control measures are suggested.

Panama diseases of banana. Journ. Jamaica Agric. Soc. **39** (1): 30, 1935.

Account of a report of the Director of the Agricultural Soc. calling attention to the spread of Panama disease of banana in Jamaica.

Diseases and pests of the Bermuda cedar. Agric. Bull. Bermuda **14**(12): 93–95, 1935.

Brief notes on cedar (*Juniperus Bermudiana*) diseases.

Arango, R[odolfo]

La enfermedad de las rayas amarillas, o mosaico de la caña de azúcar. (The yellow stripe disease or mosaic of sugar cane.) La Hacienda **16**(4): 106–109, 1921.

A popular discussion of the subject.

Archibald, R. G.

The castor oil plant (*Ricinus communis*). Trop. Agric. (Trinidad) **4**(7): 124–125, 1927.

A description of a disease caused by *Phytomonas ricini.*

Arnaud, G[abriel]

Les Asterinées. Tese No. 1598, Fac. Sci. Paris 1918, 288 p., 1918.

Arndt, C. H. & Steiner, G.

Aphelenchus parietinus as the cause of seedling losses in cotton. U.S.D.A. Plant Disease Reporter **15**(8): 82, 83, 1931.

Arthand-Berthet, J. et al

A saude dos cafezaes. (The health of coffee groves.) Bol. Agr. Sec. Agr. Com. & Obras Pub. (Brazil) **13**(9–12): **809–831,** 1912.

In this report are given the results of observations made in different plantations of coffee. Among the non-parasitic diseases con-

sidered are: cold, heat moisture, wind, wounds, the soil and fire. Among the parasitic diseases are the fungi; *Cercospora coffeicola* Berk. & Cooke, *Stilbum flavidum*, *Corticium Zimmermannii* Saac., *Rostrella coffeae* Zimm. The animal parasites are also considered. Suggestion for control and prevention are given.

Arthur, **J[oseph] C[harles]**
Leguminous rusts from México. Bot. Gaz. **39**: 385–396, 1905.

Rusts on compositae from México. Bot. Gaz. **40**: 196–208, 1905.

Uredinales. North Amer. Flora. **7**: 83–160, 1907. **7**: 161–268, 1912.

Uredinales of Porto Rico based on collections by F. L. Stevens. Mycologia **7**(4): 168–196 (5): 227–255, (6): 315–332, 1915; **8**(1): 16–33, 1916.

------------, **& Johnston, J[ohn] R[obert]**
Uredinales of Cuba. Mem. Torrey Bot. Club. **17**: 97–175, 1917.

Uredinales of Porto Rico based on collections by H. H. Whetzel and E. W. Olive. Mycologia **9**(2): 55–104, 1917.

Rusts of the West Indies. Torreya **17**: 24–27, 1917.

Uredinales of the Andes, based on collection by Dr. and Mrs. Rose. Bot. Gaz. **65**: 460–474, 1918.

Uredinales of Guatemala based on colections by E. W. D. Holway. Amer. Journ. Bot. **5**(6): 325–336, (8): 420–446, (9): 462–489, (10): 552–550, 1918.

Uredinales of Costa Rica based on colections of E. W. D. Holway. Mycologia **10**(3): 111–154, 1918.

Uredinales collected by R. Thaxter and J. B Rorer in Trinidad. Bot. Gaz. **73**(1): 58–69, 1922.

This report includes 43 species of rust fungi including a new genera and few new species, giving hosts plants.

Uredinales collected by Fred J. Seaver in Trinidad. Mycologia **14**(1): 12–24, 1922.

Las royas de los vegetales (Uredinales) del Perú. (The vegetable rusts (Uredinales.) of Perú.) Bol. Estac. Expt. Agric. Soc. Nac. Agra. Lima No. **2**, 14 p., 1929.

New genera and species of Uredinales. Bull. Torrey Bot. Club. **60**(7): 475–476, 1933.

Nomenclatural priority in the Uredinales. Journ. Arnold Arbor 15: 263–265, 1934.

Ashby, S[ydney] F[rancis]

Banana diseases in Jamaica. Bull. Dept. Agric. Jamaica **2**(6): 95–155, 1913.

A description of Panama disease and results of studies; black spot (*Cercospora* sp.,) *Pestalozzia fuscens* var. *sacchari* Walker and *Acremoniella occulta* Cawar; Bonny gate disease or banana wilt (*Sphaerostilbe musarum* n. sp.); black head diseases (*Thielaviopsis paradoxa, Pythium* or *Lasiodiplodia theobromae;* a dry bulb rot probably due to *Verticillium* sp.; *Marasmius semiustus*

Diseases of cocoa and other crops. Jamaica Dept. Agric. Bull. n. s. **2**(6): 150–155, 1913.

Brief notes on several crop plants occurring in Jamaica.

Notes on diseases of cultivated crops observed in 1913–1914. Bull. Dept. Agric. Jamaica **2**(8), 1915.

How to identify infectious plant diseases. Journ. Jamaica Agric. Soc. **20**(1): 6–12, 1916.

Annual Report of the Microbiologist 1916–17. Dept. Agric. Jamaica. Ann. Rpt. **1916–17**: 28, 1917.

Leaf roll disease of Irish potatoes. Jamaica Journ. Agric. Soc. **23**: 44–46, 1919.

A comment on Wortley's paper (Phytopathology 8: 507–529, 1918.) The author recommends preventive methods specially rouguing.

Mottling or yellow stripe disease of sugar cane. Journ. Jamaica Agric. Soc. **23**: 344–347, 1919.

A compiled account of the disease now prevalent in Porto Rico and southern United States. Description of damage, symptoms, distribution, variety attacked and control measures are given. The disease is not known in Jamaica.

Report of the microbiologist, 1918–19. Jamaica Bd. Agric. & Dept. Pub. Gard. & Plantations Ann. Rpt. **1918–19**: 26, 1919.

Brief note on thread blight of coffee caused by the fungus *Pellicularia Koleroga.*

Late blight of Irish potato. Journ. Jamaica Agric. Soc. **23**: 10–16, 1919.

Popular.

---------. Bud-rot disease of coconuts. Journ. Jamaica Agric. Soc. **22**: 331–333, 1919.

This is a discussion of *Thielaviopsis paradoxa* and *Phytophthora* sp. The forms of the diseases are (1) pine-apple leaf bitten disease, (2) hard or little leaf-bitten disease, (3) *Phytophthora* leaf-bitten disease and (4) Rhinoceros beetle leaf-bitten disease.

Bud rot of coconuts. Journ. Jamaica Agric. Soc. **23**–23–25, 1919.

Recommends methods of control.

Report of the microbiologist, 1920. Ann. Rept. Dept. Agric. Jamaica, **1920**: 24–25, 1921.

Reports Panama disease of banana, bud rot of coconuts, leaf bite of coconut. Also the isolation of *Rhizoctonia* and *Pythium* from the roots of trees.

Notes on two diseases of the coco-nut palm in Jamaica caused by fungi of the genus *Phytophthora*. West Indian Bull. **18**: 61–73, 1920.

A report of studies on *Phytophthora palmivorum* Butler and *P. parasitica* Dastur.

Leaf stalk caused by *P. parasitica* Dastur. West Indian Bull. **18**: 70–73, 1920.

The mosaic, mottling or yellow stripe disease of sugar cane. Jamaica Dept. Agric. Leaflet 13 p., 1920.

Popular.

Diseases of plant-sugar cane. Jamaica Dept. Agric. Ann. Rpt. **1920**: 26, 1920.

Brief reference to sugar-cane mosaic. First record in Jamaica.

A disease of Liberian coffee in Surinam. Agric. News (Barbados **20**(495): 126, 1921.

This note refers to Bull. 20 by Stahel, Surinam Dept. of Agric. March 1920. Occurs on *C. liberica* and to some extent on *C. arabica*. Probably a virus disease but not recognized as such. The disease is described.

The mosaic disease of cane. Agric. News (Barbados) **20**(496) 142, 143, 1921.

This note refers to a bulletin on Mosaic, Mottling, or yellow-stripe disease of cane. Published by the Jamaica Dept. Agric. 1920. The symptoms are described.

Root disease of sugar cane. Agric. News (Barbados) **20**: 158–159, 1921.

A note based partly on other publications.

Relation between cacao pod rot and coconut bud rot. Agric. News (Barbados) **20**(507): 318, 1921.

Stem-end rot of citrus fruits during shipments. Agric. News (Barbados) **20**: 334, 335, 1921.

This note refers to the Agricultural Extension Notes from the Porto Rico Agricultural Ept. Sta. in which Henricksen states that there are rots due to *Diplodia natalensis* which may be the common wound parasite *Lasiodiplodia* (*Diplodia*) *theobromae*.

Some recent observations on red ring diseases of the coconut. Agric. News (Barbados) **20**: 350, 351, 1921.

This note gives the results of infection experiments.

Some recent observations on red disease of the coconut, Agric. News (Barbados) **20**: 334, 1921.

A study of the nematode causing this disease.

Resort on the Agric. Dept. St. Lucia, Imp. Dept. Agric. West Indies. 31 p., 1922.

Bud-rots of the coconut palm in West Indies. Proc. Imp. Bot. Conference **1922**: 153–158, 1922.

Oospores in cultures of *Phytophthora faberi*. Kew Bull. Misc. Infor. **9**: 257–262, 1922.

A discussion of this fungus which attacks cacao in the West Indies.

A fungous decay of nutmegs in Grenada. Agric. News (Barbados) **21**: 519 p. 93, 1922.

This disease of nut meg (*Muristica fragrans*) is apparently due to a *Phomopsis*.

Experiments on red ring disease of the coconut in Grenada. Agric. News (Barbados) **21**: 94, 1922.

A case of a simple cure. Trop. Agric. (Trinidad) **1**(4): 62–63, 1924.

A review of Dr. Wilbrink's paper in Arch. Java Suikerindus. 1: 1923.

Bananas resistant to wilt (Panama disease) Trop. Agric. (Trinidad) **1**(11) : 172–173, 1924.

A brief reference to the disease and the possibilities of a resistant variety.

Three serious cane diseases not yet reported from the British West Indies. Proc. Ninth West Indian Agric. Conf. p. 84–89, 1925.

Obscure plant diseases of widespread occurrence. Sugar cane mosaic. Report of Proc. Imp. Conf. London, p. 122–131, 1924. (Rev. Appl. Mycol. **4**(7) : 442, 1925.)

Seed-borne diseases. Trop. Agric. (Trinidad) **2**(1) : 8–9, 1925.

A general discussion.

Researches on Panama Disease. Proc. 9th West Indian Agric. Conf. **1924**: 51–53, 1925.

A discussion of work. At one time believed the disease might be due to some cause other than *Fusarium cubense*.

Bud-rots of the coconut palm in the West Indies. Rept. Imper. Bot. Conf. London, **1924**: 153–158, 1925.

Refers mostly to *Phytophthora palmivora*.

Withertip and blossom blight of limes. Proc. Ninth West Indian Agric. Con. **1924**: 172–174, 1925.

Refers to *Colletotrichum gloeosporioides* and *Gloeosporium limetticolum*.

Mycological notes. Selection of sugar-cane in Louisiana for tolerance to mosaic disease. Trop. Agric. (Trinidad) **2**(7) : 150, 1925.

A review of a paper in Planter and Sugar Manufacturer by Edgerton & Taggart.

The perfect form of *Stilbum flavidum* Cke. in pure culture. Kew Bull. Mis. Inf. **1925**(8) : 325–328, 1925.

The material was from Trinidad. It developed a stage conforming to Maublanc & Rangels description of *Amphalia flavida*. Also refers to synonyms.

---------, & Nowell, W[iliam]

The fungi of strigmatomycosis. Ann. Bot. **40**(157) : 69–83, 1926.

Nowell described four strains of *Nematospora*. Ashby described them as (1) *Spermophythora gossypii* n. sp. on lint of cotton, in tomato fruits and in seeds of cow peas. (2) *Eremothecium cym-*

balariae Borzi in cotton bolls and tomato fruits. (3) *Nematospora gossypii* n. sp. on the lint of cotton and seeds of *Datura metel* and *Asclepias curassavica.* (4) *Nemathospora coryli* Peglion.

Behavior of some varieties of cane to mosaic disease in the Hawaiin Islands. Trop. Agrci. (Trinidad) **2**(6): 132–134, 1925. (Rev. Appl. Mycology **5**(1): 3, 1926.)

A review.

A wilt disease of bananas. Trop. Agric. (Trinidad) **3**(6): 127–129, 1926.

The author reports successful corn inoculations to tomato and tobacco. This disease was reported by Rorer in 1910 and 1911.

Mycological Notes. Trop. Agric. (Trinidad) **3**(8–9): 50–51, 71, 98, 1926.

Brief discussion of the angular leaf spot of cotton (*Bacterium malvacearum* E. F. Smith), gumming diseases of sugar cane (*B. vascularum* E. F. S.), bunchy top disease of banana (based on studies in the east), and red stripe (*Phytomonas rubrilineans* Lee et al) of sugar cane (based on work in Hawaii).

Gumming disease of sugar cane in the British West Indies. Trop. Agric. (Trinidad) **3**(3): 50–51, 1926.

Review of Matz's work in Puerto Rico and discussion of symptoms and distribution.

Mentions the finding of gummosis of sugar cane in St. Kitts and St. Lucia.

Bacterial wilt disease of bananas. Kew Bull. Misc. Inform. **1927**(1): 14–18, 1927.

The organism was obtained from bananas in Trinidad and inoculated into tomato and tobacco plants. It produced symptoms and has cultural characters of *Bacterium solanacearum.*

The oospores of *Phytophthora nicotianae* Br. de Haan, with notes on the taxonomy of *P. parasitica* Dastur. Trans. Brit. Mycol. Soc. **18**(1–2): 86–95, 1928.

These studies were based on material obtained from the Dutch East Indies, Florida and Trinidad.

The bacterial wilt of bananas and plantains. Agric. Journ. Brit. Guiana **1**(4): 217–220, 1928.

A description of the disease which is attributed to *Bacterium solanacearum* E. F. S. Also a discussion of the organism and methods for control.

Diseases of limes and sugar cane in West Indies. Kew Bull. Misc. Inf. **1929**(7) : 209–214, 1929.

Reports *Gloeosporium limetticolum* on limes in several islands and *Bacterium vascularum* on purple transparent, Caledonia Queen in Dominica and on Ba 11569 in Antigua.

Notes on two diseases of coconut palm in Jamaica caused by fungi of the genus *Phytophthora.* West Indian Bull. **18** (1–2) : 61–72, 1920.

Gumming disease of sugar cane. Tropical Agric. (Trinidad) **6**(5) : 135–138, 1929.

This paper gives the results of studies on *Bacterium vascularum* (Cobb) E. F. Sm. and of two other bacterial diseases of sugar cane.

Gloeosporium strains. Trop. Agric. (Trinidad) **8**(12) : 322–325, 1931.

This is a study of 32 strains isolated from bananas in Trinidad.

Averna-Saccá, Rosario

A Brusca. Contribucao para o estudo desta doenca em algunas plantas tropicaes e exoticas cultivadas no Estado de Sao Paulo. (La "Brusca", Contribution to the study of this disease in some tropical and exotic plants cultivated in the State of San Paulo.) Bol. Agric. Sec. Agric. Com. e Obras Pub. S. Paulo **12**(8) : 557–609, 1911.

A rather extensive, detailed work describing a disease of coffee which also attacks olives, cacao, almonds and other plants. The author believes it to be due to a physiological disturbance caused by low or high temperatures during the growing period of the plant. If the change is rapid and of short duration falling of the foliage occurs; but if the change is prolonged, death of the branches occurs. On the affected leaves and twigs several species of fungi are found but no one is the causal agent of the disease, therefore the author regards them as secondary.

Molestias cryotogámicas do caféeiro. (Cryptogamic diseases of the coffee tree.) Bol. Agric. Sec. Agric. Com. & Obras Pub. (S. Paulo) **17**(10) : 790–840, (11) : 878–922, 1916.

This is a systematic study of best known or reported diseases of coffee in Brazil caused by fungi. Gives descriptions of damage caused by each organism as well of the description of each one and is very well illustrated.

Podridao das raízes do caféeiro, producida por una forma de mycelio esteril. (Rotting of the coffee roots caused by a sterile form of a mycelium.) Bol. Agric. Sec. Agric. Com. & Obras Pub. (S. Paulo) **18**(5) : 376–380, 1917.

Description of a disease observed on the coffee tree and reported in 1914 and 1917. The supposed causal agent of the rottening of the coffee roots is the fungus *Dematophora necatrix* or a *Dendrophoma.* The author is inclined to believe that it is identical to the fungus described by D'Herelle from Honduras *Phthora vastatrix.*

Molestias das laranjeira. (Diseases of the orange.) Bol. Agr. Sao Paulo. Ser. **18**: 334–346, 1917.

Molestias encontradas sobre as folhas do fumo de gergelim provenientes de Soccono (Pernambuco) remettidas pela directoria de agricultura. (Foliage diseases of tobacco and gergelim) Bol. Agric. Sao Paulo **18**: 984–986, 1917. (Bol. Agric. Sao Paulo, **19**: 70–71, 1918.)

A disease of tobacco caused by *Cercospora solanicolum* and of *Sesamum indicum* caused by *Cercospora* sp.

Exame microscopico das jaboticabas enviadas pela directoria de Agricultura. Ferrugem das aboticabeiras. (Rust *jabotica*) Bol. Agric. (Sao Paulo) **19**: 68–69, 1918.

Reports *Uredo* sp. on leaves of *Myrciaria jaboticaba* and methods of control.

Molestia das viderias (Diseases of grapes.) Bol. Agric. Sao Paulo **19**: 214–220, 1918.

Lists *Gloeosporium ampelophagum* on *Vitis rupestris* du Lot and *V. rupestris paulista.* Also *Gl. physalosphorae* on Niagara grapes.

Molestias da macieria. (Disease of apple) Bol. Agric. (Sao Paulo) **19**: 430–433, 1918.

Reports diseases caused by *Ascochyta* sp. *Pleospora herbarum* and *Sphaerella pomicola.*

(Cryptogamic diseases of cacao and of coconut.) Bol. Agric. (Sao Paulo) **21**(1–3): 46–186, 1920.

Servico de insceccao e defesa agricola. Molestias do caféeiro. (Service of defense and plant inspection. Coffee diseases.) Bol. Agric. Sec. Agric. Comm. & Obras Pub. (S. Paulo) **21**: 4–5, 214–219, 1921.

Report on the disease causing rotting of the roots of the coffee tree. The author states that it is caused by the fungus *Dematophora necatrix.*

Molestias da videira (Diseases of the vine) Bol. de Agric. (Sao Paulo) Ser. **22**(1–2): 6–15, 1921.

Observation on *Capnodium salicinum* and *Pestalozzia uvicola.*

Algunas das molestias cryptogamicas do tobaco. (*Nicotiana tabacum*) (Some cryptogamic diseases of tobacco. (*Nicotiana tabacum*) Bol. Agric. Sec. Agric. Comm. & Obras Pub. (S. Paulo) **23**(7): 201–268, 1922.

Algunas das molestias cryptogámicas mais communs da baunilla (*Vanilla planifolia*) nos estados de S. Paulo o S. Catherina. (Some of the most common cryptogamic diseases of vanilla (*Vanilla planifolia*) in the States of S. Paulo and S. Catherine.) Bol. Agric. Sec. Agric. Com. & Obras Pub. (S. Paulo) **23**(9–10): 282–305, 1922.

Os gasteromycetes mais communs nas hortas nos pomares e nos campos. (The most common gasteromycetes in the vegetable gardens, orchards and fields.) Bol. Agric. Sec. Agric. Com. & Obras Pub. (S. Paulo) **23**(9–10): 306–310, 1922.

Segunda contribucao para o estudo das moestias cryptogamicas do caféeiro. (Second contribution to the study of the cryptogamic diseases of coffee.) Sec. Agric. (S. Paulo) Ser. Publ. 63 p., 1925.

Algunas das molestias cryptogamicas que atacan os fructos do cacauerio no littoral paulista. (Some of the cryptogamic diseases which attacks the cacao fruits in the S. Paulo coast.) Bol. Agric. Sec. Agric. Com. & Obras Pub. (S. Paulo) **26**: 518–539, 1925.

As manifestacoes pathologicas que acompahan o desenvolvimiento da broca *Stephanoderes hampeii,* Ferr. (*S. coffeae* Hag.) nos frutos on nas sementes de cafeiro. (The pathological manifestations acompanying the development of *Stephanoderes hampeii* Ferr. (*S. Coffeae* Hag.) in the fruits and seeds of the coffee trees.) Com. de Estudio de Debellacao da Praga Cafeira. Sec. Agr. Com. e Obras Pub. **15**, 87 p., 1926.

Extensive and interesting work very well illustrated with diagrams in relation to the fungi that develop in the lesions of the coffee berries caused by the borer *Stephanoderes hampei.*

Contribuicao para o estudio das molestias cryptogamicas das roseivas (Fungous diseases of roses) Sec. Agric. Com. e Obras Publ. Estado Sao Paulo (Brasil) 67 p., 1926.

Descriptions, symptoms and distributions of diseases of roses. Also the life histories of the fungi.

Algunas molestias cryptogamicas novas do systema radicular do caféeiro. (Some new cryptogamic diseases of the coffee root system.) Com. de Estudio e Debellacao da Praga Caféira. Sec. Agric. Com. & Obras Pub. 17 p., 1926.

In this paper the author considers in detail several diseases of the coffee roots. Among the diseases mentioned are those caused by the fungi, *Stilbum radiciperda, Polyporus* sp., *Glomerella coffeicola* f. *Radicicola* Averna, *Colletotrichum radicicola, C. radiciperda, Fusarium heterosporium* and other *Fusaria.*

Sobre a presenca de um protozoario nos tecidos da canna de assucar atacadas pelo "Mosaico". (On the presence of a protozoa in tissue of cane attacked by mosaic.) Bol. de Agric. Sao Paulo, (Brasil) **27**(8–9): 183–204, 252–273, 303–319, 388–398, 1926; **28**: 173–182, 1927.)

A histological study in which the author describes a protozoan living in diseased plants. The author believes this organism to be the causal agent.

Os entomophagos cryptogamicos na broca do caffeiro (*Stephanoderes hampei* Ferr.) encontrados en S. Paulo. (The entomogenous fungi of the coffee borer (*Stephanoderes hampei,* Ferr.) found in S. Paulo). Bol. Agric. Sec. Agric. Com. & Obras Pub. Bol. Agric. S. Paulo. **31**: 10–24, 195–213, 1930.

Contribucao para o estudio da biologia da *Thielaviopsis paradoxa* (de Seynes) Höhn., da Bananeira e da canna de assucar e sua pretensa relacao com o *Melanconium sacchari,* Massee. (A contribution to the study of the biology of *Thielaviopsis paradoxa* (de Seynes) Höhn, from Banana and sugar cane and its supposed relationship with *Melanconium sacchari,* Massee) Rev. Agric. (Brasil) **7**(3–4): 114–130; 1932.

A study of these two fungi in Brazil.

Um entomophago cryptogamic do *Caconema radiciola* (Greef) Cobb *Fusarium mauroi* n. sp. (A cryptogamic entomophage of *Caconema radiciola* (Greef) Cobb (*Fusarium mauroi* n. sp.) Rev. Agric. (Brasil), **8**(3–4): 93–101, **1933**.

A description of the nematode.

Azevedo, H. De

Estado sanitorio vegetal des Cacaoerios em Belmonte. (Sanitary status of the cacao groves in Belmonte.) Correiro-Agric. Bahia **3**: 249–252, 270–274, 1925.

Azevedo, N.

Nota sobre um lichen perjudicial ao Guaco (*Mikania scandens* L.) (Notes on a licher injurious to "Guaco" *Mikania scandens* L.) Rodriguesia **1**(3): 33–34, 1935.

Report of a lichen (*Strigula elegans* Fée & Müll f. *hirtella* Müll Arg.) leaf infection of the medicinal plant known in Årgentine as "Guaco" (*Mikania scandens* L.). Preventive measures are recommended.

A "variola" do Mamóéiro. (A "pox" of *Carica Papaya*). Rodriguesia **1**(2) : 91–93, 1935.

Description to a leaf spot of *Carica Papaya* (*Asperisporium Caricae*). The perfect stage (*Mycosphaerella Caricae*) was found in the pericarp of the fruit. Control measures are suggested.

Nota sobre o "Diplodia" do Algodoeiro (Note on a *Diplodia* of cotton). Rodriguesia **1**(2) : 97–98, 1935.

Report of the record of *Diplodia gossypina* on cotton bolls grown in experimental plots in Brazil during 1933.

Azzi, R.

Uma nova molestia da canna de assucar. (A new disease of sugar cane.) Bol. Agric. (Sao Paulo) Ser. **28**(9–10) : 526–532, 1927.

Refers to Fawcett's work on cold chlorosis of sugar cane.

Báez, Horacio

La rulla o polvillo de trigo (Wheat rust), Defensa Agric. (Uruguay) **3**: 163–167, 1922.

The disease is caused by *Puccinia graminis tritici*.

Báez, J. R.

Criptogamas parásitas observadas en la Prov. de Entre Ríos, sobre las plantas cultivadas. (Parasitic cryptogams observed in the Prov. of Entre Ríos, on cultivated plants.) Argentina Bol. Mins. Agric. de la Nación. **26**(1) : 3–21, 1921.

Record of several fungous diseases occurring in Entre Ríos Prov. on cultivated plants.

Bain, F. M.

Bronz leaf wilt of the coconut palm. Agric. Soc. Trinidad and Tobago. **35**(12) : 507–521, 1934.

Popular.

Report on wilt disease of coconuts for 1934. Admin. Rep. Dir., Agric. Trinidad & Tobago. **1934**: 50–51, 1935.

Baker, R. E. D.

Maize stripe disease. Trop. Agric. (Trinidad) **10**(8) : 221, 1933.

A brief note with reference to the transmission of this disease by *Peregrinus maidis*.

Stripe disease of Maize. Trop. Agric. (Trinidad) **10**(12) : 352, 1933.

A brief description.

Papaw root and collar-rot. Trop. Agric. (Trinidad) **10**(11): 328–329, 1933.

A description of the disease and experiments. Cause not definitely determined, but *Botryodiplodia theobromae* was found.

Root disease of lime in Monserrat. Trop. Agric. (Trinidad) **13**(6): 147–148, 1936.

Although not considered primarily parasites the following organisms were obtained from branches and roots of lime trees affected with root disease and associated with attacks of Diaprepes larvae: *Botryodiplodia Theobromae, Phomopsis* (*Diaporthe*) *Citri,* and a *Fusarium* sp. Also *Sphaerostilbe repens* a weak parasitic fungus. Withertip (*Gloeosporium limetticolum*) has so far caused no serious losses, probably due to the dry climate of the Island.

Notes on Trinidad fungi. I. *Phytophthora.* Trop. Agric. (Trinidad), **13**(12): 330–332, 1936.

Ballou, H. A.

Thrips and black blight. Trinidad Bot. Dept. Bull. Misc. Inform. **44**: 132–135, 1904.

Report on the prevalence of some pests and diseases. West Indian Bull. (Barbados) **13**(4): 333, 1913.

Insect pests and plant diseases. West Indies Imp. Dept. Agric. Grenada Dept. Agric. Ann. Rpt. **1918–19**: 14–26, 1919.

Balls, W. L.

Notes on internal disease of cotton seed. Imperial Dept. of Agric. Agric. News (Barbados) **14**: 314, 1916.

Balmaseda, F. J.

Tesoro del Agricultor Cubano. 2nd. Edition. **2**: 154, 1893.

A manual.

Bancroft, C[laude] K[eith]

New West Indian Cacao pod disease. West Indian Bull. **11**: 34–35, 1910.

Description of a new species. *Colletotricum Cradwickii.*

A handbook of the fungus diseases of West Indian Plants. London, 70 p., 1910.

Fungi causing diseases of cultivated plants in the West Indies. West India Bull. **10**(3): 235–268, 1910.

A list of diseases with descriptions in most cases.

A disease of the cacao plant. Roy. Bot. Gard. Kew, Bull. Misc. Inform **3**: 93–95, 1910.

---------- A note on the occurrence of *Fomes semitostus* in British Guiana. Journ. Bd. of Agric. British Guiana. **7**(2) : 91, 1914.

A brief mention.

A fungus disease of pepper (*Capsicum* spp.). Journ. Bd. Agric. British Guiana **1**(3) : 139–141, 1914.

The disease is described. It is attributed to *Colletotrichum nigrum* E. & H.

Fungus notes. Journ. Bd. Rgric. Brit. Guiana. **7**(3) : 141, 1914.

A leaf spot on an orchid (*Phalaenopsis esmeralda,* Regnerii is attributed to *Uredo orchidis* Wint. A mildew on rose is attributed to *Sphaerotheca pomosa* Lev.

A disease affecting the sisal hemp plant. Journ. Bd. Agric. British Guiana **7**(4) : 181–182. 1914.

The disease is caused by *Colletotrichum agaves* Cav. The symptoms are described.

The "new disease" or "dry disease" of the sugar cane. Journ. Bd. Agric. British Guiana. **7**(4) : 183–187, 1914.

The disease is attributed to *Marasmius sacchari* and symptoms are described.

---------- A leaf disease of Para rubber. Journal Bd. Agric. British Guiana **7**(1) : 37–38, 1913.

Plant diseases in British Guiana. Brit. Guiana Dept. Sci. & Agric. Ann. Rpt. **1914–15**(2) : 7–10, 1915.

Report on the South American leaf disease of Para rubber. Journ. Bd. Agric. Brit. Guiana. **10**: 13–33, 1916.

The disease is attributed to *Fusicladium macrosporum* Kuyper (*Aposphaeria Ulei* P. Henn. of Brazil). The symptoms of the disease described. The author also discusses a die back and root diseases caused by *Fomes semitostus* and *Hymenochaete noxia.*

The author also refers to two leaf spots in Brazil,—*Dothidella relei* P. Henn. & *Phyllachora buberi* P. Henn.

The leaf disease of rubber. Conditions in Suriname. Journ. Bd. Agric. Brit. Guiana. **10**: 93–103, 1916.

This is the disease attributed by the author to *Fusicladium macrosporum* Kuyper. It has been described by Massee as *Passalora heveae* and by Stahel as *Melanopsammopsis heveae*. It attacks *Heveae braziliensis*, *H. guyanensis* and *H. confusa*.

The official gazette of British-Guyana. **41**: 374–379, 1916.

The mango and bread fruit disease. Journ. Board Agric. British Guiana. **11**: 75, 1918.

The disease is caused by *Gloeosporium mangiferae* and the losses are heavy. Recomends spraying with Bordeaux mixture.

Diseases in plants with special reference to fungi parasitic on crops in British Guiana. Journ. Bd. of Agric. Brit. Guiana. **11**: 47–57, 1918.

A popular paper containing list of diseases known to occur in British Guiana.

Barber C[hares] A[lfred]

Report on diseases affecting the sugar cane in Barbados. St. John, 6 p., 1893.

The mosaic or mottling disease of sugar cane. The main facts of the case to date. Int. Sugar Journ. **23**(265): 12–19, 1921.

A review of the studies on sugar-cane mosaic by Johnston, Grey, Edgerton, Earle, Fawcett, Stevenson and Brandes.

Root disease of the cane in Barbados. Intern. Sugar Journ. **25**: 514–518, 1923.

A review of the recent literature and of our knowledge of the subject.

La situación actual en relación con el matizado en Cuba. (The present position as regards mosaic in Cuba.) Rev. Agric. Puerto Rico. **13**(4): 265–272, 1924. (Int. Sugar Journ. **26** (309): 469–473, 1924.

Experimental Agriculture in Jamaica. The Campaign against mosaic. Int. Sugar Journ. **26**(309): 474–476, 1924.

Account of the position of sugar-cane industry in Jamaica in regard to sugar-cane mosaic disease and campaign to erradicate it.

The Havana Conference on Cane diseases. Inter. Sugar Journ. **30**(359): 575–582, 1928.

A record of the discussion on diseases of sugar-cane. The greater part of the discussion was devoted to mosaic disease of sugar cane..

Bardales, Manuel A.
Algunas enfermedades fungosas de los cafetales en Guatemala. (Some fungous diseases of the coffee grove in Guatemala.) Bol. Agr. & Caminos, Guatemala. **7**(9): 433–436, (10): 495–499, (11): 543–546, 1928.

The author describes and gives methods for controlling the following diseases.

(1) *Koleroga* or "candelillo" caused by the fungus *Corticium Koleroga.*

(2) The leaf spot or "Iron stain" caused by the fungus *Stilbella flavida* and

(3) The root disease of coffee caused by the fungus *Rosellinia aquila.*

Barker, A. C.
Report on failure of Cacao crop in Dominica. 1892–93, Supplement to Leeward Is. Gazette, April 27, p. 52, 1893.

Barker, H[enry] D.
Plant diseases and pests in Haiti. Int. Rev. of Sci. & Prac. of Agr. S. S., **4**(1): 184–187, 1926. (Rev. of Appl. Mycology **5**(9): 583, 1926.)

Barkelay, J.
Banana diseases. Journ. Jamaica Agric. Soc. **16**: 90–92, 1912.

Barreto B[raulio] T.
Algo sobre la extirpación del matizado. (Facts on mosaic eradication.) Rev. Agric. Com. & Trab. Cuba. **7**(4): 12–13, 1924. (Agricultura (Cuba) **2**: 8–9, 1924.)

La situación de la enfermedad "Mosaico" en la Provincia de Camagüey. (Mosaic disease situation in the province of Camagüey.) Agricultura (Cuba) **1**: 150, 152, 1925.

Barrett, Mary F.
Three common species of *Auricularia.* Mycologia **2**(1): 12–18, 1910.

Barrett, O[tis] W[arren]
Fungus diseases. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1903**: 449–450, 1904.

Notes on fungus diseases of occurrence in Puerto Rico.

Diseases of Yautía. Puerto Rico Agric. Expt. Sta. Bull. **6**: 22–23, 1905.

Fungus diseases. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1904**: 397–399, 1905.

Report of the Entomologist and Botanist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1905**: 21–23, 1906.

Notes upon miscellaneous crops. Proc. of the Agric. Soc. of Trinidad. **7**: 303, 1906.

Cacao pests of Trinidad. Proc. Agric. Soc. Trinidad & Tobago. **7**(10): 281–304, 1907.

Barthe, A. E.

Una enfermedad del cacao. Rev. Agric. Santo Domingo. **6**(5): 103–112, 1910.

Popular.

La oficina de Sanidad vegetal de la Secretaría de Agricultura Comercio y Trabajo. Resumen de las plagas ya estudiadas y combatidas. (Review of the plagues so far studied and combatted.) Rev. Agric. Com. & Trab. (Cuba) **3**: 290, 292, 296, 1920.

A report on the bud rot of the coconut with recommendations for its control.

Bartlett, A. W.

Notes on some plant diseases. Brit. Guiana Bot. Gard. Ann. Rpt. **1906–07**: 20–22, 1907.

Brief notes on crop plant diseases.

Report on fungus diseases of cotton. Brit. Guiana Official Gazette. March 13, 1907.

Baylis, H. A., & Daubaney, R.

A synopsis of the families and genera of Nematodes. London 1926.

An important paper for the study of nematodes.

Beaurepaire Aragao, Henrique de

Über *Phytomonas Francai.* Anhandlungen aus dem Gebiete der Auslandskunde. Hamburgesche Universitä, Bd. 26, Reihe D. Medicin, Bd. 2, Festschrift Prof. B. Nocht. (n. d.)

Sur un flagellé du latex de *Manihot palmata: Phytomonas Francai* n. sp. Compt. Rend. Soc. Biol. **97**(27): 1927.

Pesquizas sobre *Phytomonas francai*-Untersuchungen über *Phytomonas francai.*) (This article is published in German and Portuguese.) Mem. Inst. Oswaldo Cruz (Brazil) **25**(4): 299–306, 1931.

Beckett, Edgar.

Wilt disease of coconut palms in Trinidad. Part I. Agric. Journ. of Brit. Guiana. **1**(2): 127–128, 1908.

A review of Briton-Jones paper in Trop, Agric May, 1928.

Beille, L.

(Diseases and enemies of cacao.) Journ. Agric. Trop. **13**(144): 167–172, (145): 193–197. (146): 236–238, 1913.

Belgrave, W. N. C.

Notes on the South American leaf disease of rubber. British Guiana, Journ. Bd. Agric. **15**: 132–138, 1922.

This appears to be the same as an article in Agricultural Bulletin. Federated Malay States. The author refer to a paper by Stahel. Bull. No. 34. Jan. 1907, Dept. v. d. Landbouw in Surinam.

Bell, A[rthur] F[rank]

Cane diseases in Louisiana and West Indies. Australian Sugar Journal. **18**(10): 601–607. 1927. (The Planter (Abstract) **78**(8): 147–148, 1927.)

The distribution of sugar-cane mosaic. Ref. Book Sugar Industry of the World. **7**: 31–32, 1929.

Report of the results of the observations made by the author during 1924–28, while visiting the most important sugar-cane producing centers.. Concludes by inserting a list of the seven major diseases of sugar cane with their geographical distribution.

Sugar-cane diseases of North America and the West Indies. Queensland Agric. Journ. **27**(2): 99–104. 1927.

Bell of Australia traveled through the sugar cane region and published this report in which he mentioned several diseases.

Benatora, R.

Fungos entomogenos dos *Citrus* (Entomogenous fungi of *Citrus*). Rodriguesia **1**(2): 7–10, 1935.

Brief popular notes on the following entomogenous fungi found on *Citrus*, in Brazil: *Aschersonia aleyroidis*, which is very commonly parasitic on *Aleyrodidae* on orange leaves; *A. goldiana* which chiefly attacks *Dialeurodes citrifoli; A. turbinata* which attacks coccids; *Sphaerostilbe aurantiicola, S. flammea, S. coccidophthora, Podonectria coccicola, Myriangium duriaei* and *Septobasitium albidum* which is abundantly present in most *Citrus* plantations in Brazil and may cause considerable damage by infecting large areas of the surface of the fruit near the peduncle.

Berkeley, Miles Joseph.

Enumeration of some fungi from Santo Domingo. Ann. Mag. Nat. Hist. **II, 9**.

Notices of some Brazilian fungi . . . being a sequel to the contributions towards a flora of Brazil by G. Gardner. London Journ. Bot. **2**: 629–643, 1843

------------, **& Curtis, M. A.**

Exotic fungi from the Schweinitzian herbarium, principally from Surinam. Journ. Acad. Nat. Sci. Phila II. **2**: 277–294, 1853.

Río Negro fungi. His decades of fungi LI, LXII. Hook Journ. Bot. & Kew Garden Misc. **8**: 129–144, 169–177, 193–200, 233–241, 272–280, 1856.

On some new fungi from México. Journ. Linn. Soc. Bot. **9**: 423–425, 1866.

On a collection of fungi from Cuba. Part II including those belonging to the families Gasteromycetes, Coniomycetes, Hyphomycetes, Plycomycetes and Ascomycetes. Journ. Linn. Soc. Bot. **10**: 391, 1869.

------------, **& Cooke, M. C.**

The fungi of Brazil including those collected by J. M. Trail, in 1874. Linn. Soc. Journ. Bot. **15**: 363–397, 1876.

Fungi brasiliensis in provincia Río de Janeiro a clar Dr. A. Glancion lecti: In Warming, W. Chmbolae and flora Brasiliae Part XXV Vidensk. Madd. Naturh. For Kjobenh **31/32**: 31–34, 1879, 1890.

Betancourt, P. E.

El Mosaico en Cuba. (The mosaic in Cuba.) Rev. Agr. Com. & Trab. Cuba. **7**: 23–25, 1925.

Bertoni, M. S.

Una nueva enfermedad del cafeto. (New coffee disease) Rev. Agr. Cien. Apl. Paraguay **1**(4–5): 211–223, 1898.

A summarized account of the coffee-plant diseases. The author describes them briefly including a new one which attacks the coffee roots, which is caused by the fungus *Rhizoctonia subepigea* n. sp.

Contribución al estudio de la gomosis del naranjo. Agronomía (Puerto Bertoni) Paraguay, **5**: 77–89, 1911.

La gomosis de los citrus y un nuevo medio preventivo y curativo. (Citrus gumosis and means to prevent and cure it.) Ann. Cient. Paraguayos. Ser. **2**: 408–421, 1919.

Besadola, Giacomo

Hymenomycetes Fuegiani a cell viris P. Dusen et O. Nordenskgöld lecti ofver K. Svenska Vetensk-Acad. Förhandl **57**: 311–330, 1900.

Bianchi, Angel T.

Enfermedad de la papa. (Potato diseases.) Sucor (Argentina) 1(6): 8–9, 1920.

A discussion of dry rot (*Fusarium solani*) and wet rot (*Phytophthora infestans.*)

Enfermedades de la papa (Potato diseases). Defensa Agric. (Uruguay) **2**: 31–32, 1921.

A brief discussion of *Phytophthora infestans, Fusarium solani* and *Bacillus amylobactor.*

Bird, Maurice

Soil hygiene in its relation to disease of cane. Journ. Bd. of Agric. Brit. Guiana. **18**: 256–261, 1925.

The toxic action of magnesia on sugar cane. Agric. Journ. of Brit. Guiana. **3**(3): 176–179, 1930.

A brief of discussion.

Bitancourt, A[gegislan] A.

Doencas cryptogamicas das plantas cultivadas. (Cryptogamic diseases of cultivated plants.) Agronomía, Brazil, **1**: 239–253, 1930.

As manchas das Laranjas. Descricao das principais manchas, podridoes e outras alteracoes das Laranjas, e dos meios para combate-las. (Orange spots. A description of the chief spots, rots, and other disorders of oranges and measures for their control.) Inst. Biol. Defensa Agric. e Animal, Sao Paulo, Folh. **53**, 135 p., 1934.

This is a very useful publications about the chief orange troubles occurring in Brazil. It contain practical control measures.

----------, **Goncàlves, R. D., & Carneiro, J. G.**

Relacao das doencas e fungos parasitas observados na ceccao de phytopathologia durante as annos 1933 e 1934. (Report on the diseases and parasitic fungi observed in the section of phytopathology during the year 1933 and 1934.) Arch. Inst Biol. Def. Agric. Anim., S. Paulo. **4**: 206–211, 1935.

The report contains records of *Leptosphaeria musarum* on banana, *Chaetothyrina musarum* on Giant fig fruits and a storage rot due to *Stachylidium theobromae.* Also a fruit rot of avocado due to *Acrostalagmus cinnabarinus.* Also a species of *Pestalozzia* on the branches of avocado. Beets were affected by curly top.

As doencas de virus dos Citrus (Virus diseases of Citrus). Biologico, Sao Paulo (Brazil) 1(8): 255–262, 1935.

Although not conclusively demonstrated the author states that comparative studies based on the relevant literature and his own observa-

tions have shown considerable analogies by the syptons caused on citrus trees by psorosis, leprosis, ring blotch and zonate chlorosis and would tend to confirm the view that these diseases are due to virus agencies. He compares the symptoms in different species in Brazil and in United States.

-------------, & Jenkins, Anna E.

Areolate spot of Citrus caused by *Leptosphaeria bondari.* Phytopathology **25**(9) : 884–886, 1935.

English and Latin diagnoses are given of *Leptosphaeria bondari* n. sp. the agent of aerolate spot a disease of Citrus occurring in Brazil, Dutch Guiana and Venezuela.

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A *Hemileia* e o Brasil (*Hemileia* and Brazil.) Rev. Inst. Cafe S. Paulo (Brasil) **10**(105) : 2106–2109, 1935.

Brief popular notes giving the history and distribution of the fungus *Hemileia vastarix,* the causative agent of coffee leaf rust. The author attributes the great Brazilian coffee production to the absence of this destructive disease.

Una protozoario parasita do Cafeéiro. (A protozoon parasitic on coffee.) Rev. Inst. Café. **10**(107) : 2486–2490, 1935.

The author reports a cochineal insect (*Cerococcus parahybensis*) and and the protozoon *Rhizoecus coffeae* associated with phloem necrosis of coffee in the plantations of Parahyba and Pernambuco, Brazil. He discusses Stahel's (from Surinam) observations on the subject.

----------, & Jenkins, Anna E.

Elsinoe Fawcetti, the perfect stage of the Citrus scab fungus. Phytopathology **26**(4) : 393–395, 1936.

English and Latin diagnosis are furnished of *Elsinoe Fawcetti* n. sp. the causal organism of scab lesions on *Citrus nobilis* rind in Brazil.

Perfect stage of the sweet orange fruit scab fungus. Mycologia **28**(5) : 489–492, 1936.

The authors state that the perfect stage of the sweet orange fruit scab fungus [*Sphaeceloma Fawcettii viscosa*) was found in 1936 on Bahia Naval orange (*Citrus sinensis*) from San Paulo, Brazil. A description of the fungus follows. The conclusions are that the morphological differences indicated are believed to warrant the separation of the variety *viscosa* from *Elsinoe Fawcetti* and its erection into distinct species for which *E. australis* n. sp. is suggested. The conidial stage is correspondingly renamed *S. australis* Bitancourt & Jenkins.

Stomiopeltis citri n. sp. agente da "fuligem" dos Citrus no Estado de Sao Paulo. (*Stomiopeltis citri* n. sp the causal agent of "sooty blotch" of Citrus in the State of Sao Paulo.)

Arq. Inst. Biol. de Defensa Agric. & Animal, (Sao Paulo) **5**, 12 p., 1934.

The author gives a detailed morphological account of a fungus, considered as a new species. It causes sooty blotch on citrus. The species affected are sweet and sour oranges, lemons and *Citrus trifoliata.*

Blain, Walter Leroy

Comparative morphology of Dothideaceous and kindred stromata. Mycologia, **19**(1) : 1–20, 1927.

Blanchard, E[verard] E.

Principales insectos y enfermedades que perjudican el cultivo de la yerba mate. (Chief insects and diseases detrimental to the cultivation of "yerba mate.") Min. Agric. Nac. (Buenos Aires) Sec. Prop. e Inform. Circ. **735**, 42 p., 1928.

This paper gives a record of several diseases.

————————, **& Carrera, César**

Causas que originan pérdidas en los cultivos de trigos en el sur de la Prov. de Buenos Aires, Este y Norte de la Pampa. (Causes that originate losses in wheat culture in the South of Buenos Aires, Province and East & North of the Pampa.) Argentina, Bol. Min. Agric. **32**(1) : 3–10, 1933.

Most of this report is devoted to the losses caused by different forms of wheat foot-rot.

Principales insectos y enfermedades que perjudican los cultivos cítricos en la República Argentina. (Principal insects and diseases which damage the citrus crops in the Argentine Republic.) Min. Agric. Nac. (Buenos Aires) Sec. Prop. & Inform. Circ. **815**, 114 p., 1930.

Notes on symptoms, etiology and control of a great number of diseases of citrus in Argentine. Control methods and fungicide formulas are given.

Bodkin, G. E.

Black blight. Journ. Bd. Agric. Brit. Guiana. **5**: 83, 84, 1912.

A black fungus which the author call *Aschersonia aleyroidis.*

Bondar, Gregorio

Heterodera radicicola. Bol. Agr. (Sao Paulo) Brazil, **16**(4) : 329–330, 1915.

Account of the author's observations in regard to the nematode, *Heterodera radicicola.* He believes that this nematode does not attack coffee roots under normal conditions.

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La régénération des plantations de caféiers dans les Antilles. Bulletin des Séames de la Sociéte National d' Agriculture de France, Paris, **59**: 683–687, 1899.

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The authors discusses three diseases of the sun hemp *(Crotalaria juncea)* as follows: wilt *(Fusarium udum* Butler), anthracnose *(Colletotrichum curvatum* n. sp.) and a leaf spot (*Cercospora* sp.). On the sword bean *(Canavalia ensiformis)* a disease caused by *Sclerotium rolfsii*. On cow pea *(Vigna catjag)* a leaf spot *(Cercospora cruenta)* a mildew *(Oidium)* and a mosaic. On the pigeon pea *(Cajanus indicus)* a rust *(Uromyces dolicholi)* and a stem canker. On the Belgian bean *(Stizolobium aterninum)* a leaf spot (*Cercospora* sp.) and a disease caused by *Corticium vagum*.

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Mycological notes, I Trop. Agric. (Trinidad) **4**(5) : 88, 1927.

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Mycological and bacteriological problems (in sugar-cane production.) Trop. Agric. Suppl. (Trinidad) **4**(9) : 51, 1927.

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Witch broom disease. Trop. Agric. (Trinidad) **6**(1) : 20–22, 1929.

A review of Stell's witch broom disease of cacao and its control.

Wilt disease of coconut palms in Trinidad. (Part I) Suppl. to Trop. Agric., (Trinidad) **5**: 1–2, 1928.

The coconut is attacked by two diseases; the bud rot (*Phytophthora palmivorum*) and ring rot (*Aphelenchus cocophilus*). The author gives a historical discussion of these two diseases. He then describes a false wilt, bronze leaf wilt caused by soil and a yellow leaf or tapering stem disease. Also control measures.

Root diseases in the British West Indies and a note on *Diaporthe perniciosus* Marchal or a closely related species. Trop. Agric. (Trinidad) **5**(4) : 79–82, 1928. (5) : 107–110.

The author gives a general discussion of *Macrophomina phaseoli* in the West Indies, a list of synonyms and also a discussión on *Sphaerostilbe repens, Rosellinia pepo, R. bunodes, Pythiacystis citrophora, Fomes lignosus, Diaporthe perniciosa,* die back and wither tip of limes, etc.

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Observations on sypre (*Cordia alliodora* L.) in Trinidad with special reference to canker disease. (*Puccinia cordiae* (P. Henn.) Arth.) Part I. Mycologia. Mem. Imp. Coll. Trop. Agric. Trinidad No. **3**: 3–7, 1930.

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The author observed since 1929 a stripe disease of corn which occurred in Trinidad and closely resembling that described by Stahl in Cuba. That disease was associated with the leafhopper *Peregrinus maidis* as vector, both in Cuba and Tanganyka. The author described the disease and his observations on inoculation studies. A similar disease resembling the one under discussion was observed also on sorghum.

Thread blights in Trinidad. Journ. Imp. Coll. Trop. Agric. **11**(2): 55–57, 1934.

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Notes on some other fungous diseases in Trinidad. 1933. Journ. Imp. Coll. Trop. Agric. **11**(2): 67–68, 1934.

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The results of spraying experiments. This treatment also controls the leaf spot (*Colletotrichum zingiberis*) of ginger.

Preliminary trials with a combined insecticide and fungicide.—Trop. Agric. **10**(3): 80–84, 1933.

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Problems connected with root disease of sugar cane in Antigua. Trop. Agric. (Trinidad) **13**(1): 5–8. 1936.

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The vegetation on Mona Island, Ann. Mo. Bot. Garden **2**: 33–58, 1915.

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Investigations in connection with cacao-root disease. St. Lucía Dept. Agric. Rpt. **1913–14**: 8, 1914.

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The cultivation of yams (Fungous and insect pests.) Trop. Agric. (Trinidad) 8: 231–236, 1931.

Bruner, S[tephen] C[ole]

La "Phomopsis" de la berenjena (Eggplant Phomopsis.) Rev. Agric. Com. & Trab. Cuba. **1**: 368–369, 1918.

La pudrición del tomate y modo de evitarla (Decay of tomatoes and methods of prevention.) Rev. Agric. Com. Trab. (Cuba) **1**: 300–301, 1918.

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A report on several diseases.

----------- La "Phomopsis" de la berenjena (Phomopsis disease of egg-plant.) Rev. Agric. Com. Trab. (Cuba): **1**: 468–469, 1918. (Rev. Agric. México) **4**: 31–32, 1919.)

Recommendations for control.

----------- Caída de las nueces e inclinación de las hojas del cocotero en Cuba. (Nut fall and leaf drop of coconut in Cuba.) Rev. Agric. Com. Trab. (Cuba) **2**: 96, 1919.

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----------- La enfermedad del mosaico o de rayas amarillas de la caña de azúcar en Cuba. (The mosaic or yellow stripe disease of sugar cane in Cuba.) Rev. Agric. Com. & Trab. Cuba. **2** (9): 437–441, 1919.

Record of the occurrence of the disease and review.

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----------- Lista preliminar de las enfermedades de las plantas de importancia económica para Cuba. (Contribución al estudio de la fitopatología.) (Preliminary list of the diseases of the plants

of economic importance for Cuba. A contribution to the study of plant pathology.) Cuba, Est. Expt. Agron. Inf. Ann. **1918–20**: 723–763, 1920.

---------- La pudrición negra del cacao. (Black rot of cacao.) Informe Ann. Estación Expt. Agron. (Cuba) **1918–20**: 627–628, 1920. (Rev. Agric. Com. & Trabajo (Cuba) **2**: 630–636, 1919.)

The black rot disease caused by *Phytophthora faberi* has been reported in Cuba for first time.

The disease is described and control recommended.

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A review of work on resistant varieties in Puerto Rico, Hawaii and Jamaica. Gives a list of susceptible and resistant varieties.

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Records the occurrence of mosaic disease on sugar cane in Taco Taco in the Province of Pinar del Río, Cuba.

---------- La muerte de los cocoteros. (The death of coconut trees.) Rev. Agric. Com. Trabajo (Cuba) **5**(1): 9–10, 1922.

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---------- Sobre la transmisión de la enfermedad del "Mosaico" o "Rayas Amarillas" en la caña de azúcar. (On the transmission of Mosaic or "Yellow Stripe Disease" of sugar cane.) Rev. Agr. Com. & Trab., Cuba. (**5**(1): 11–22, 1922.

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---------- El mosaico y otras enfermedades y plagas de la caña en Cuba. (Mosaic and other cane diseases and pests in Cuba.) Mundo Azucarero **2**(1): 20–27, 1923. (Louisiana Planter. **70**(22): 452–455, 1923. Rev. Appl. Myco. **2**: 523–524, 1923.)

The mosaic does not appear to spread as rapidly in Cuba as in Puerto Rico. Recommends the use of resistant and immune varieties.

La enfermedad del mosaico de la Caña de Azúcar. (Mosaic disease of sugar cane.) Cuba, Est. Expt. Agron. Circ. **60**, 16 p., 1923. (Facts About Sugar **18**(14) : 329, 1924.

A discussion of conditions in Cuba.

La enfermedad del mosaico de la caña de azúcar. (Mosaic disease of sugar cane.) Argentina Ind. Azucarera **29**(366) :228–237, 1924.

La situación respecto al "Mosaico" de la caña de azúcar en Jamaica. (The situation in regard to sugar cane in Jamaica.) Rev. Agric. Com. & Trab. Cuba. **8**(1) : 74–76, 1926. (Agricultura, Cuba **1**(1) : 160–162. 1925.)

El problema de la libre importación de papas, (The problem of free importation of potatoes.) Rev. de Agric. Com. Trab. (Cuba) **8**(2) : 36–39, 1926.

Refers to danger of introducing diseases.

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La enfermedad "Verruga" de las habas de Lima. (Scab of Lima beans) Est. Expt. Agron. (Santiago de las Vegas, Cuba) Circ. **74**, 58 p., 1931.

The disease is caused by a species of *Elsinoe* closely related to *Elsinoe canavaliae.*

Informe del departamento de entomología y fitopatología. Ejercicio de 1929 a 1930. Repub. Cuba. Sec. Agric. Com. Trab. Estación Expt. Agron. **1931** : 5–74, 1931.

A general report.

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Identity and host relations of the *Elsinoe* of lima bean. Journ. Agric. Res. **47**(10) : 783–789, 1933.

The results of studies made in Cuba.

Brunini, Vicente
Resultados obtenidos en algunas experiencias sobre carbón volatil y caries del trigo. (Some results obtained in some experiences on loose smut and caries of wheat.) Nuestra Chacra (Argentina) **4**(21) : 9–11, 1929.

Experimental data of plant resistance to wheat loose smut and caries.

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Einige neue Pilze. (Some new fungi.) Ann. Mycol. **31** : 7–12, **1915.**

Burt, E[dward] A[ngus]
Some hymenomycetous Fungi from South America. Bull. Torr. Bot. Club. **29**: 571–572, 1902.

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Odontia sacchari and *O. saccharicola,* new species on sugar cane. Ann. Missouri Bot. Gard. **4**(3): 233–236, 1917.

Descriptions of these two new species.

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Corticiums causing Pelicularia disease of the coffee plant, Hypochnose of Pomaceous fruits and Rhyzoctonia diseases. Ann. Missouri Bot. Gard. **5**: 119–132, 1918.

Busck, August
Report on the investigations of diseased coconut palms in Cuba. U.S.D.A. Br. Ent. n. s. Bull. **38**: 20–23, 1902.

Byars, L[uther] P[arris]
Notes on the citrus-root nematodes, *Tylenchus semi-penetrans.* Phytopathology **11**(2): 90–94, 1921.

Cabrera, César
Informe preliminar sobre una enfermedad nueva comprobada en los Citrus de Bella Vista (Corrientes) (Preliminary report on a new disease of citrus at Bella Vista (Corrientes). Argentina, Bol. Mins. Agric. **34**(3–4): 375–380, 1933.

Report on an outbreak of anthracnosis of the citrus (*Colletotrichum gloeosporioides* Penz.)

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El "mildiú" del cacao en las islas de St. Thomas y Príncipe. Bull. Ofic. Soc. Agric. Cuba. **17**(3): 213–216, 1914.

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Estudio sobre las enfermedades de la papa. (Studies on potato diseases.) Rev. Nac. Agr. Soc. Agr. (Colombia) **26**: 670–676, 1935.

Calvino, M[ario]
Informe de los años 1918, 1919 y 1920 de la Estación Experimental Agronómica Santiago de las Vegas, Cuba. (Anual Report for the years 1918, 1919, 1920 of the Agricultural Experiment Station, Cuba) p. 547–550, 1920.

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Nuevas orientaciones en la selección de caña para semilla. (New orientations in sugar-cane seed selection.) Rev. Agric. Com. & Trab. Cuba, **5**(12) : 8–10, 1924.

Camacho, C.
La agricultura de Tacna (Agriculture in the province of Tacna) (Chile) 27 p., 1923.

Reports gummosis on *Citrus.*

Os adubos verdos e as safras de cobertura na cultura cafeeira. I, Importancia e afeitos. D. N. C. Rev. Dep. Nac. Café, (Río de Janeiro) **5**: 807–811, 1935.

(Co. 290 cane at Campos, Brazil. Observations on cane culture in Brazil.) Brasil Assuc. **5**(3) : 127–138, 335–341, 1935. (Facts About Sugar (Abstract) **30**(8) : 304–305, 1935.)

Record of observations on sugar-cane variety resistance to mosaic

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Sugar cane diseases in Brazil. Brasil Assuc. **7**(4) : 209–213, 1936. (Facts About Sugar (Abstract) **31**(12) : 471, 1936.)

According to the author the major sugar-cane diseases in Brazil are gummosis (*Bacterium vascularum*), mosaic, Serch and red stripe (*Bact. rubrilineans*). Account is given as to varietal resistance and behavior.

Sugar-cane diseases in Brazil II, Brasil Assuc. **7**(5) : 289–290, 1936. (Facts About Sugar (Abstract) **31**(11) : 427, 1936.)

Continuation of preceeding paper. The minor sugar-cane diseases are given.

Caminha Filho, Adriao
Relatorio de mez de setembro de 1925, do auxiliar de inspector agrícola de defesa do cafe-na zona de Matta. (Report for the month of September 1925, of the assistant agricultural inspector for the defence of coffee in the zone of Matta. Bol. Minist. Agr. Ind. & Comm. Río de Janeiro **15**: 125–127, 1926.

Campbell, Leo
Some species of *Plasmopara* on composites from Guatemala. Mycologia **24**: 330–333, 1932.

Campos, F. O.
El cáncer del cacao (Cacao canker). Rev. Agric. **16**: 53–55, 1920.

Campos Novaes, José De
A cura de gomose dar *Laranjeiras Phythiacystis citrophora.* (The cure of orange gummosis (*Pythiacystis citrophora*) Bol. Agric. Sao Paulo, Ser. **29a**, (11–12) : 684–689, 1928.

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Quadro synoptico e practico da phytopathologia brasileira. (Synoptic and practical table of Brazilian phytopathology.) Characas e Quintaes **35**: 425–432, 1927; **40**: 282–288, 1929.

Camuñas Manuel
Report of the Commissioner of Agriculture and Labor. 19th. Ann. Rpt. Govt. Pto. Rico to Secretary of War, Washington, D. C. Appendix IX, pp. 685–707, 1919. (Rev. Appl. Ent. ser A, **9**: 332, 1919.)

A record of the occurrence of mosaic of sugar cane in Puerto Rico.

Canu, G.
Después del oidium. (After the *Oidium.*) Bol. Soc. Nac. Agric. Chile. **63**: 319–321, 1931.

Carvalho, J. N. de
O cafeiro e suas pragas na Parahyba. (The coffee tree and its pests in Parahyba.) Agron. Ann. Soc. Brasil. Agron. **1**: 99–118, 1930.

The two principal diseases of coffee in Parahyba, Brazil, are caused by the fungi *Cercospora coffeicola* and *Rosellinia necatrix.* The author describes both diseases and the organisms.

Cardín, Patricio
Informe del Depto. de Path. Vegetal y Entomología. Cuba Ext. Expt. Agron. Santiago de las Vegas. Inf. Ann. **1909–14**: 110–111, 1915.

Carleton, M[ark] A[lfred]
Note on the Fusarium wilt disease of bananas. Science, N. S. **56**(1458): 663–664, 1922.

Refers to a paper by E. Gaumamm ''Over een bactericelee vatbundelziekte der bananen in Nederlandsch, Indie, Meded. V. H. Instituut V. Plantenziekten, No. 48, Dept. N. Landbouw, Nijverheid en Handel, pp. 135, 1921, in which an effort is made to discredit the work of Brandes (Phyto. 8(9):339–389, 1919.

Carleton gives the results of studies confirming the work of Brandes.

Carrera, César
Informe de las observaciones y experimentaciones efectuadas sobre una nueva enfermedad aparecida en los *Citrus* de Bella Vista (Corrientes). (Report on the observations and experiments carried out on a new *Citrus* disease that has developed at Bella Vista (Corriente) Bol. Minist. Agric. Buenos Aires, **37**(1–4): 15–36, 1935.

After inoculation studies with three species of *Fusarium* (*F. oxysporum* var. *aurantiacum*, *F. solani* var. *Martini* and *F. solani*) with negative results, the author concludes that the primary factors are nutritional and physiological. Control measures are given.

Fusarium de la República Argentina. Estudio y clasificación de algunas especies. (*Fusarium* in the Argentine Republic. A study and classification of certain species.) Physis, Buenos Aires, **12**(41): 43–47, 1936.

An annotated list of several species of *Fusarium* occurring in Argentina.

Catoni, Luis A[ntonio]

Una enfermedad del cocotero que no queremos en Puerto Rico. (A coconut palm disease which we do not want in Puerto Rico.) Puerto Rico, Ins. Expt. Sta. Circ. **43**, 7 p., 1921.

Cengia-Sambo, M.

Licheni della terra del Fuoco recolth da G. B. De Gasperi nel 1913. (Lichens from Tierra del Fuego collected by G. B. De Gasperi in 1913.) Bull. Soc. Bot. Stal. **1926**(4/5): 81–92, 1926.

Chardon, C[arlos] E[ugenio]

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Descrizione del fungo che cause la "moniliasi" del cacao. (A description of the fungus causing "moniliasi" of cacao.) Phytopath. Zeitschr.. **6**(5) : 539–542, 1933.

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Genera of fungi. New York, 496 p., 1931.

Clerot, L. F.

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Ustilaginales. North Amer. Flora **7**: 1–82, 1906.

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Citrus-root nematode. Journ. Agric. Res. **2**(3) : 217–230, 1914.

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A description of this species which was found in the West Indies.

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Two new instruments for biologists. Proc. Linn. Soc. N. South Wales. **5**: 157–167. 1922.

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The coconut industry, its economic importance and a serious disease of the coconut caused by a nematode. Journ. Wash. Acad. Sci., **13**: 189, 1923.

Cockerell, T[edore] D[ru] A[ison]
Additions to the fauna and flora of Jamaica. Journal Inst. Jamaica **1**: 32, 1891.

The sugar-cane fungus. Mus. Inst. Jamaica Notes No. **8**: 1, 1892.

The new coffee disease. Mus. Inst. Jamaica. Notes No. **27**: 1, 1892.

Report about a new disease of coffee caused by a fungus which attacks the leaves.

Coker, W[illiam] C[hambers]
The Clavarias of the United States and Canada. 209 p. Chapel Hill, 1923.

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The Gasteromycetes of the Eastern United States and Canada 201 p., Chapel Hill, 1928.

Collens, A. E.
New fungus diseases. Bull. Dept. of Agric. Trinidad. n. s. **61**: 33–40, 1909.

Refers to *Eutypa crumpens* Massee on fallen cacao tree. Also to *Diplodia cacaoicola,* and *D. maydis.* Also *Nectaria theobromae* on exposed roots of *Gliricidia maculata* (Nicaraguan cacao shade) and on stems of mangoes and avocado pears. This is followed by a tabulation listing insects and fungi with brief descriptions and treatments.

Collins, F[rank] S[hipley]
Myxophyceae; in Britton N. L. The Bahama Flora p. 618–626, 1920.

Colón, E[dmundo] D[imas]
La enfermedad de las rayas amarillas. (Yellow stripe diseases.) Puerto Rico Ins. Exp. Sta. Circ. **14**: 3–6, 1918.

Popular account of this disease new to Puerto Rico.

Yellow stripe of sugar cane. Porto Rico Ins. Expt. Sta. Rpt. **1918–19**: 66–68. 1919.

The absorption spectrum of the chlorophyll in yellow striped sugar cane. Journ. Dept. Agric. Puerto Rico. **3**(4): 43–53, 1919.

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A review of work done at the Insular Experiment Station of Puerto Rico.

Chemical changes in yellow striped sugar cane. Puerto Rico Ins. Expt. Sta. Ann. Rpt. **1920–21**: 18–19, 1921.

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Informe del Departamento de patología vegetal. (Report of the Department of plant pathology.) pp. 147–207. En Primer Informe Anual de la Estación Agronómica de Cuba. **1904–05.** 1906.

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Insects and diseases of corn, sugar cane and similar plants.—Insectos y enfermedades del maíz, caña de azúcar y plantas similares. Estación Central Agronómica de Cuba, Bull. **7**, 16 p,. 1907.

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A manual.

------------ The status of plant pathology in Puerto Rico. Journ. Dept. Agric. Puerto Rico **7**(3) : 3–14, 1923.

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A discussion of virus diseases with special reference to sugar cane mosaic.

------------ The search for the cause of mosaic. Facts About Sugar **19**(24) : 570–571, 1924.

A popular paper.

------------ Annual Report of the Division of Plant Pathology and Botany for the Fiscal year 1923–24. Puerto Rico. Ins. Expt. Sta. Ann. Rpt. **1923–24**: 78–87, 1924.

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------------ El pasado y el futuro de la patología vegetal. (The past and future of plant pathology.) Rev. Agric. Puerto Rico, **11**: 33–39, 47–52, 1923.

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A disease of the nuts and leaves due to *Thielaviopsis paradoxa.*

------------ Bacterial wilt of cosmos (Preliminary paper). Journ. Dept. Agric. Puerto Rico **8**(4) : 14, 1924.

Name of organism not determined.

------------ A bacterial wilt of eggplant. (Preliminary paper.) Journ. Dept. Agric. (Puerto Rico. **8**(4) : 15, 1924.

Organism not determined but proved later to be *B. solanacearum.*

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Spraying citrus fruits in Puerto Rico. Puerto Rico Ins. Expt. Sta. Circ. **88**, 23 p., 1925.
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Relationship of cane variety to diseases. Journ. Dept. Agric. Puerto Rico. **9**(4) : 277–281, 1925.
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Enfermedades de las hojas de tabaco. (Leaf diseases of tobacco.) Rev. Agric. Puerto Rico. **15**(6) : 282, 1925.
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————————— Chlorosis de la piña. (Pine apple chlorosis.) Rev. Agric. Puerto Rico. **15**(6) : 296–297, 1925.

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A popular discussion of the disease in Puerto Rico.

————————— Histology and cytology of sugar-cane mosaic. Journ. Dept. Agr. Puerto Rico, **9**(1) : 5–27, 1925. (Rev. Appl. Mycol. **5**: 387–388, 1925. Rev. Agric. Puerto Rico **15**(6) : 291–293, 1925.)

The author gives a review of the literature on this phase of the subject and the results of his own studies. The chlorotic areas are slightly thinner than the green areas. The green areas are the same as a healthy leaf of the same age. The intracellular bodies are present but difficult to find. Chloroplasts are smaller and fewer in chlorotic than in healthy cells.

————————— Sugar production and cane diseases. Facts About Sugar **20** (45) : 1068–1069. 1925. (Rev. Appl. Mycol. **5**: 187, 1925. Rev. Agric. Puerto Rico. **15**(6) : 273–276, 1925.)

Popular.

————————— El mosaico de la caña de azúcar en Puerto Rico. (Sugar-cane mosaic in Puerto Rico.) Rev. Agric. Puerto Rico. **17**(5) : 6–13. 1926. (Facts About Sugar **22**(9) : 203, 1927. Rev. Appl. Mycol. **6**: 318–319, 1926.)

Popular.

Photo-synthesis of the sugar-cane plant. Journ. Dept. Agric. Puerto Rico. **10**(3–4): 239–242, 1926. (Rev. Appl. Mycol. **7**: 198, 1926.)

The author reviews the literature on this phase of the subject and makes comparative studies of sugar-cane mosaic with his previous studies on peach yellow and little peach. In the case of sugar cane the chlorotic areas do less photosynthetic work than the green areas but the translocation of carbohydrates is normal. In the case of peach yellows and little peach the translocation of carbohydrates is almost or completely inhibited.

———— Report of the Division of Botany and Plant Pathology. Puerto Rico Ins. Expt. Sta. Ann. Rpt. **1924–25**: 98–107, 1926.

———— Epiphytic orchids a serious pest on citrus trees. Journ. Dept. Agric. Puerto Rico. **10**(2): 5–9, 1926.

Ionopsis utricularioides and *Leochilus labiatus* killed large branches on trees.

———— The eye-spot disease of sugar cane. Journ. Dept. Agric. Puerto Rico **10**(3–4): 207–227, 1926.

The history, distribution and symptoms of the disease and the organism (*Helminthosporium sacchari*) with the results of laboratory and field studies.

———— Informe de la Estación Experimental Insular, Puerto Rico, 1925–1926. (Annual Report of the Insular Experiment Station, Puerto Rico, 1925–26.) In the Director's Report, p. 44–46, 1927.

———— Experiencias con la gomosis de la caña de azúcar. (Experiments on the gumming disease of sugar cane.) Rev. de Agric. Puerto Rico. **18**(5): 281, 1927.

Popular.

———— Sugar cane gummosis. Ref. Book Sugar Indus. of the World. **6**(6): 72–73, 1928.

Popular.

———— The effect of mosaic on the content of plant cell. Journ. Dept. Agric. Puerto Rico. **10**(3–4): 229–238, 1926. (Rev. Appl. Mycol. **7**: 197–198, 1928.)

The author gives a review of the literature and the results of his own studies. The chlorotic areas are indistinct in the very young leaves. They become distinct with exposure to light. Later the chlorotic areas tend to become green. The chloroplasts are smaller and fewer in number than in the green areas, but increase in size and

number with age. The chlorotic areas increase in size as a result of cell growths and cell division and by the encroachment of the virus on the surrounding cells. The nuclei are usually enlarged and deformed.

------------ Some effects of mosaic on the contents of the cells. Phytopathology (Abstract) **17**(1): 57, 1927.

------------ Report of the Division of Botany and Plant Pathology. Puerto Puerto Rico Ins. Expt. Sta. Ann. Rpt. **1927–28**: 24–25, 59–66, 1929.

------------ The gummosis of sugar cane (first paper.) Journ. Dept. Agric. Puerto Rico, **12**(3): 143–177, 1928.

The author gives a discussion of the history, geographical distribution, origin, spread, symptoms, causal organism, the results of field tests, and inoculation experiments to determine resistance and susceptibility of varieties.

------------ Annual Report of the Insular Experiment Station, Puerto Rico, 1926–27. In the Director's Rept. p. 29, 34, 37, 1929.

------------ The eye spot disease of sugar cane (*Helminthosporium sacchari*). Plant. & Sugar Mafg. **83**: 101–102, 1929.

------------ The dry top rot of sugar cane. Ref. Book. Sugar Ind. World. **7**: 32, 1929.

Popular.

------------ Tres enfermedades de la caña de azúcar encontradas recientemente en Puerto Rico. (Three diseases of sugar cane recently found in Puerto Rico.) Rev. Agr. Puerto Rico. **22**(7): 15–16, 39, 1929.

A popular paper on pokkahbong (*Fusarium moniliforme,*) brown stripe (*Helminthosporium stenospilum*) and red stripe (*Phytomonas rubilineans*.

------------ Life history of *Ligniera vascularum* (Matz) Cook (Formerly known as *Plasmodiophora vascularum*). Journ. Dept. Agric. Puerto Rico. **13**(1): 19–29, 1929.

A description of the disease. The author transfers the species from *Plasmodiophora* to *Ligniera*.

------------ The gummosis of sugar cane (Second paper). Journ. Dept. Agric. Puerto Rico **13**(2): 73–76, 1929.

Continuation of the first paper.

------------ The development of the spores of *Plasmodiophora vascularum* Phytopathology (Abstract) **19**(1): 91–92, 1929.

The effect of some mosaic diseases on the cell structure and the chloroplasts. Phytopathology (Abstract) **20**(1) : 142, 1930.

The effect of some mosaic diseases on cell structure and on the chloroplasts. Journ. Dept. Agric. Puerto Rico. **14**(2) : 69–101, 1930.

The author gives a review of the literature and the result of his own studies which are a continuation of previous studies and in which he has used sugar cane, canna, tobacco, tomato and cowpea. The chlorotic areas are thinner than the green areas. The active agent inhibits the differentiation of the cell structure and of the chloroplasts. The earlier the attack, the greater the inhibition. The active agent does not penetrate the various parts of the leaf equally. The result is the chlorotic areas and variations in cell differentiation. There is no reason to believe that structure and development of chloroplasts are modified by the virus. It is a true case of inhibition. The development of cell structure is permanently checked but the chloroplasts of the chlorotic areas increase in size and number.

----------- La situación actual en enfermedades de la caña de azúcar en Puerto Rico. (The present situation on sugar cane diseases in Puerto Rico.) Rev. Agric. Puerto Rico. **24**(12) : 227–231, 1930.

Brief popular notes on disease of sugar cane in Puerto Rico with recommendations for their control.

----------- Gomosis de la caña P.O.J. 2878 en Puerto Rico. (Gummosis of P.O.J. 2878 cane in Puerto Rico.) Rev. Agric. Puerto Rico. **24**(3) : 102, 1930. (Fact About Sugar, **26**(6) : 257, 1931.)

A strain of *Bacterium vascularum* attacking the sugar cane variety P.O.J. 2878, which is considered immune.

----------- Report of the Division of Botany and Plant Pathology. Puerto Rico. Ins. Expt. Sta. Ann. Rpt. **1929–30**: 93–109, 1931.

----------- Undescribed symptoms of mosaic in Puerto Rico tobacco. Phytopathology (Abstract) **21**(1) : 117, 1931.

A brief description.

----------- Distribución geográfica de las enfermedades de la caña de azúcar (Geographical distribution of sugar-cane diseases). Rev. Agric. Puerto Rico **25**(5) : 170–172, 1930. (Facts About Sugar **26**(1) : 24–26, 1931.)

A chart is given with explanatory notes, showing the distribution of cane diseases throughout the world.

———— Enfermedades de la caña de azúcar en Puerto Rico. (Sugar-cane diseases in Puerto Rico.) Ins. Expt. Sta. Puerto Rico. Circ. **94**, 45 p., 1931.

Descriptions of the important diseases of sugar cane in Puerto Rico with recommendations for their control.

———— Undescribed symptoms of mosaic in Puerto Rico. Phytopathology (Abstract) **21**(1) : 117, 1931.

———— New virus diseases in Puerto Rico. Phytopathology (Abstract) **21**(1) : 124, 1931.

Six unreported virus diseases are briefly described. 1. A mosaic of *Crotalaria striata;* 2. A rare mosaic of *Commelina longicaulis;* 3. A bunchy-top of *Carica Papaya;* 4. A variegation of *Abutilon hirtum;* 5. A variegation of several species of *Sida;* 6. A mottling of mulbery (*Morus album.*)

———— Some undescribed symptoms of mosaic in Puerto Rican tobacco. Journ. Dept. Agric. Puerto Rico **15**(2) : 189–191, 1931.

The author gives the results of cross-inoculation experiments and of studies on the histology of leaves of various ages. The results of these later studies are: (1) When leaves are inoculated there is an inhibition of the development of cell structure and chloroplast; (2) When chlorotic areas are formed on leaves with fully developed tissues there is no change in cell structure but the growth of the chloroplasts was inhibited; (3) That the enlargement of the mosaic areas on young leaves is due to cell division and growth and not to invasion of surrounding cells by the virus.

———— The leaf spots of tobacco; an after symptom of mosaic. Journ. Dept. Agric. Puerto Rico. **15**(2) : 183–187, 1931.

This appears to be the same as the spot described by Mayer in 1886 and which Iwanowski and Polowzoff described later as "Pokenkrankheit". The author believes these spots to be a late symptom of tobacco mosaic.

———— New virus diseases of plant in Puerto Rico. Journ. Dept. Agric. Puerto Rico. **15**(2) : 193–195, 1931.

This paper records mosaic on *Adenoropium gossypifolium* and *Ipomoea Nil.*

———— The effect of mosaic on cell structure and chloroplasts. Journ. Dept. Agric. Puerto Rico. **15**(2) : 177–181, 1931.

The author reports the result of studies of the effect of mosaic on the cell structure and chloroplasts of *Capsicum annuum, Crotalaria striata, Carica papaya, Eucharis amazonica* and a hybrid *Amaryllis.* The results confirm the author's previous opinion that the effect of many viruses is inhibitory.

La roña de la toronja en Puerto Rico. (*Sphaceloma Fawcetti.*) (Grapefruit scab in Puerto Rico. *Sphaceloma Fawcetti.*) Ins. Expt. Sta. Puerto Rico. Circ. **92**, 15 p., 1931.

Popular.

Informe Anual de la Sección de Botánica y Fitopatología. En el Informe Anual del Comisionado de Agricultura y Comercio de Puerto Rico, 1930–31. (Annual Report of the Division of Botany and Phytopathology. In the Annual Report of the Commissioner of Agriculture and Commerce of Puerto Rico, 1930–31.) p. 127–129, 1931.

Annual Report of the Division of Botany and Plant Pathology. In the Annual Report of the Insular Experiment Station, Puerto Rico, **1928–29**: 60–66, 1932.

Report on the international survey of the diseases of sugar cane. 4th Congress Int. Soc. Sugar Cane Tech. 1932, Bull. **128.** 15 p., 1932.

Data on the geographical distribution of diseases of sugar cane. Compiled from data furnished by plant pathologists.

Thielaviopsis paradoxa, an important disease of sugar cane. Journ. Dept. Agric. Puerto Rico. **16**(2): 205–211, 1932.

A review of our knowledge of this fungus with a discussion of its behavior in Puerto Rico.

Rotting of sugar-cane cuttings in Puerto Rico. Phytopathology (Abstract) **22**(1): 7, 1932.

The rotting is due to *Thielaviopsis paradoxa.*

Gummosis of sugar cane. Proc. 4th Cong. International Soc. Sugar Cane Tech. 1932. (Facts About Sugar (Abstract) **27**: 260–261, 1932.)

The disease in Puerto Rico. A discussion of strains.

Melanconium sacchari, parasite or saprophyte. Proc. 4th. Cong. Internat. Soc. Sugar Cane Tech. 1932. (Facts About Sugar (Asbtract) **27**(6): 261, 1932.)

A brief discussion of the writer's studies. The organism is a weak parasite.

----------, & Morales Otero, Pablo

Gum-producing organism in sugar cane. Journ. Dept. Agric. Puerto Rico. **17**(4): 271–286, 1933.

The history of this organism with the results of additional laboratory and inoculation studies with 36 strains.

———— Parasitism of *Marasmius sacchari*, Wakker. Proc. 4th Int. Cong. Soc. Sugar Cane Technologists. 1932.

———— *Marasmius sacchari*, a parasite on sugar cane. Journ. Dept. Agric. Puerto Rico, **16**(2): 213–226, 1932.

———— Rotting of sugar-cane cuttings in Puerto Rico. Phytopathology **22**: 7, 1932. (Facts About Sugar **27**: 259–260, 1932.)

———— Action inhibitrice du virus des mosaïques sur l'evolution cellulaire. (Inhibitary action of mosaic virus in the cellular evolution.) Deuxiéme Congres International de Pathologie Compáre. p. 1–8, 1932.

This paper is a résumé of some of the works of the author published in The Journal of the Dept. of Agric. Puerto Rico."

———— The gummosis of sugar cane. Int. Soc. of Sugar Cane Tech. Bull. **35**, 12 p., 1932.

A very brief review of this disease.

———— White spot of pineapple. Journ. Dept. Agric. Puerto Rico. **17**(4): 311–313, 1933.

A review of the literature. The writer found that the disease in Puerto Rico was due to climatic conditions.

———— The pineapple disease of sugar cane in Puerto Rico. Journ. Dept. Agric. Puerto Rico. **17**(4): 305–309, 1933.

The results of studies on *Thielaviopsis paradoxa*.

This paper was published in La Hacienda 32(5): 177–178, 1937 (without the consent or approval of the Station or author) under the incorrectly translated title of "Una enfermedad de la caña de azúcar en Puerto Rico", and from La Hacienda in Brasil Acucareiro 9(5): 344–345, 1937.

———— Patho-anatomy of roots attacked by nematodes. Journ. Dept. Agric. Puerto Rico **17**(4): 315–319, 1933.

A partial review of the literature, descriptions of the injuries and comparisons with similar injuries due to other causes.

———— Informe Anual de la Sección de Botánica y Fitopatología. En el Informe Anual del Director de la Estación Experimental Insular, 1931–32 (Annual Report of the Division of Botany and Phytopathology. In the Annual Report of the Director of the Insular Experiment Station of Puerto Rico, 1931–32). p. 36–37, 1933.

———— Virus diseases of plants. Sci. Mo. **36**(4): 355–359, 1933.

Popular.

Informe Anual de la Sección de Botánica y Fitopatología. En el Informe Anual de la Estación Experimental de Puerto Rico, 1932–33. (Annual Report of the Division of Botany and Phytopathology. In the Annual Report of the Insular Experiment Station, Puerto Rico, 1932–33). p. 76–91, 1934.

Annual Report of the Division of Botany and Plant Pathology. In the Annual Report of the Agricultural Experiment Station of Puerto Rico, **1933–34**: 125–141, 1935.

Relation of insect injuries and root diseases in sugar cane. Phytopathology (Abstract) **25**(1): 12, 1935.

Root diseases of sugar cane in Puerto Rico. Part I. Normal structure of roots. Part II. A new parasitic fungus in the roots of sugar cane. Journ. Agric. Univ. Puerto Rico. **19** (2): 121–128, 1935.

The author describes the normal structure of healthy sugar-cane roots and gives account of a new parasitic fungus observed in stained sections of sugar-cane roots. The symptoms of its presence are discussed and a Latin diagnosis is given of the fungus *Olpidium sacchari* n. sp.

Annual report of the Plant Pathologist for the fiscal year of 1934–1935. In the Annual Report of the Agricultural Experiment Station of Puerto Rico. p. 22–29, 1937.

Enfermedades nuevas o poco conocidas de la caña de azúcar en las Antillas. Rev. Agric. Puerto Rico. (Suppl. No. 1) Memoir. Assoc. Sugar-Cane Tech. Puerto Rico, **1935–36**: 5–13, 1936.

Short descriptions of several new diseases of minor importance.

Phloem necrosis in the stripe disease of corn. Journ. Agric. Univ. Puerto Rico **20**(3): 685–688, 1936.

Examination of corn affected with white stripe disease in Puerto Rico showed phloem necrosis to be invariably present, accompanied by a thickening of the walls of the epidermal cells, fibrous cells and sheath cells. The chloroplasts in the cells of healthy plants were larger than those in the chlorotic parts of affected plants and in severely affected regions the nuclei showed desintegration.

Annual Report of the Division of Botany and Plant Pathology. In the Annual Report of the Agricultural Experiment Station of Puerto Rico, **1935–36**: 39–46, 1937.

————————, **Otero, José I[dilio], López Domínguez, F[rancisco] A[ntonio]** et.al.

History of the first quarter of a century of the Agricultural Experiment Station at Río Piedras, Puerto Rico. Bull. **44**, 123 p., 1937.

This history of all the work of all the Divisions of the Station contains a brief review of the work in botany and plant pathology on pages 68–73.

Cook, O[rator] F[uller]

Leaf-cut or tomatosis, a disorder of cotton seedling. U.S.D.A. Circ. **120**: 29–34, 1913.

This is a brief discussion of a disease which may be due to a virus.

Branchysm, a hereditary deformity of cotton and other plants. Journ. Agric. Res. **3**: 387–399, 1915.

It has not been proved that this is a virus disease but it has many of the characteristics of this group of plant diseases.

Malformation of cotton plants in Haiti. A new disease named smalling or stenosis causing abnormal growth and sterility. Journ. Heredity **14**(7): 323–335, 1923.

The author describes a disease which he calls "smalling" or "stenosis". Certain characters resemble some of the virus diseases but it is neither contagious nor infectious.

Acromania or "crazy-top" a growth disorder of cotton. Journ. Agric. Res. **28**(8): 803, 1924.

It is not known that this disease is caused by a virus. The author describes the symptoms of this disease and also a brachysm, tomosis, hybosis, citosis and stenosis.

Cook, W[alter] R[obert] Ivimey

On the life history and systematic position of the organism of the dry top rot of sugar cane. Journ. Dept. Agric. Puerto Rico. **16**(14): 409–418, 1932.

Attributes the disease to *Amoebosporum vascularum* n. sp. and *A. vascularum* n. sp.

Cooke, M[ordecai] C.

Mycographia seu Icones Fungorum. I. Discomycetes. London 120 p., 1875.

Exotic fungi. Grevillea **9**: 10–11, 1880; **9**: 97–10, 1881; **10**: 123, 1882.

Taxonomic; records *Uredo oxalidearum* Cke. and *Sphaerella psammisiae* Cke.; *Pellicularia Koleroga* Cke.; *Leptostroma discoidea* Cke.; *Forula Sphaerella* Cke.; *Stilbum flavidum* Cke.; *Sphaerella coffeicola* Cke. as new species found in Venezuela.

Xylaria and its allies. Grevillea **11**: 81–94, 1883.

--------- Hypoxylon and its allies. Grevillea **11**: 121–140, 1883.

Notes on Hypocreaceae. Grevillea **12**: 77–83, 1884.
Taxonomic; records *Hypocrea Fendleri* Berk. & Curt. from Venezuela.

Praecursores ad monographiam Polyporum. Grevillea **15**: 19–27, 1886.
Taxonomic: records *Polyporus Venezuelle* Berk. & Curt., *Polystictus coryophyllaceous* Berk. & Curt., *Poria geogena*, Berk. & Curt., *P. flavipora* Berk. & Curt., *P. porotheloides* Berk. & Curt., from Venezuela.

Two coffee diseases. Pop. Sci. Rev. **15**: 161.

--------- Two coffee diseases. Pop. Sci. Rev. No. **59**: 135.

The coffee disease in South America. Linn. Soc. Journ. Bot. **18**: 361–467, 1881.
Description of the disease known in Venezuela as "Candelilla" and "Iron stain". The organisms causing this coffee leaf disease are *Stilbum flavidum* Ck. and *Sphaerella coffeicola.*

Some exotic fungi Grevillea **16**: 121, 1888.
Taxonomic, records *Marasmius cinctus* Berk. from Venezuela.

Costa Lima, Angelo da

A propósito de una comunicacao do Dr. Puttemans sobre o mosaico da cana de assucar. (About a letter from Dr. Puttemans related to sugar-cane mosaic disease.) Characas e Quintaes **34**: 30–42, 1926.

(Mosaic and thrips in Brazil.) Bol. Agric. Ind. Comm. Brazil. **2**: 38–41, 1926.
The writer believes that *Thrips minuta* var. *Puttemansi* is the vector for mosaic of sugar cane.

Relatorio sobre a doenca dos cafeeiros de Pernambuco. (Report on coffee diseases in Pernambuco.) Secret. Agr. Com. Ind. Viacao e Obras Pub. 27 p., 1928.

Costa, A. S. & Krug, H. P.

Eine durch *Ceratostomella* hervorgerufene Welkekrankheit der *Crotalaria juncea* in Brasilian. (A wilt disease of *Crotalaria juncea* in Brazil caused by *Ceratostomella.*) Phytopath. Zeitschr. **8**(5): 507–513, 1935.
Description and diagnosis of the fungus *Ceratostomella fimbriata* as the cause of a wilt disease of *Crotalaria juncea* in Brazil.

Cousins, H. H., & Sutherland, J. B.
Plant diseases and pests. Report of the Secretary of the advisory committee on the banana industry. Dept. Sci. Agric. Jamaica Ann. Rpt. **1929**: 15–19, 1930.

Cowgill, H[orace] B[ranson]
Report of the Plant Breeder. Puerto Rico. Ins. Expt. Sta. Rpt. **1917–18**: 78–104, 1918.

Crawley, J[osiah] T[homas]
Control of the mosaic disease in Cuba. Facts About Sugar **2**: 554–555, 1927. (Rev. Appl. Mycol. **6**: 752, 1927.)

Gives results of roguing and seed selection in sugar cane.

Croker, Ricardo
El peligro de las enfermedades del cafeto. (The danger of coffee diseases.) Rev. Cafetera de Colombia **5**(48–50): 1676–1777, 1933.

Brief notes on coffee berry diseases. 1. Berry spot (*Cercospora coffeicola*). 2. The berry black spot (*Colletotrichum coffeanum*). 3. The berry brown spot (*Colletotrichum coffeanum*).

Cross, W[illiam] E[rnest]
The Kavangerie cane. Louisiana Planter & Sugar Manuf. **63**: 397–399, 1919.

Kavangerie proved to be immune. The author also gives a discussion of it desirable and undesirable qualities.

The Java–Argentine seedling sugar canes. Louisiana Planter. **66**: 184, 1921.

Resistance to mosaic.

La Estación Experimental Agrícola de Tucumán. Su contribución a la Industria Azucarera de Puerto Rico. (The Agricultural Experiment Station at Tucumán. Its contribution to the Sugar Industry of Puerto Rico.) Rev. Indus. Agric. Tucumán, **13**(11–12): 207–211, 1923.

A controversy.

----------, **& Fawcett, G[eorge] L[orenzo]**
La enfermedad del mosaico en Luisiana. (The mosaic disease in Louisiana.) La Industria Azucarera, Argentina **30**(376): 975–979, 1924.

Mosaic resistant Java canes in Tucumán. Facts About Sugar. **19**: 250–251, 1924.

Popular.

Present needs in cane disease control. A rejoinder to Mr. A. H. Lee. Int. Sugar Journal. **27**: 26–31, 1925.

The author states that the plant pathologists are responsible for the introduction and spread of sugar-cane diseases rather than the Government Experiment Stations and individuals. He gives some data concerning downy mildew, Fiji disease and mosaic.

Ensayos y observaciones relativas al efecto del mosaico sobre los rendimientos culturales de las variedades P.O.J. 36, 213 y 2725. (Experiments and observations relative to the effect of mosaic on the cultural yields of the varieties. P.O.J. 36, 213, and 2725.) Rev. Ind. Agric. Tucumán, **24**(3–4): 57–76, 1934.

Studies on cultural yield of sugar-cane varieties. Details given in tabulated form.

Cañas resistentes al mosaico en Tucumán. (Canes resistant to mosaic at Tucumán.) Industria Azucarera, Argentina **30** (370): 660–661, 1924. (Louisiana Planter & Sugar Manuf. **73**: 468–469, 1924. Facts About Sugar **19**(11): 250–261, 1924. Int. Sugar Journ. **27**(124): 551, 1925.)

Popular. Deterioration of certain varieties believed to be due to mosaic. Controversy.

El mosaico de la caña en Cuba. (Sugar-cane mosaic in Cuba.) Rev. Agric. Com. & Trab. Cuba **7**(4): 9–10, 1924.

Popular.

Enfermedades de la caña de azúcar en Tucumán. (Sugar-cane diseases in Tucumán.) Sugar **27**(2): 103–104, 1925.

La importación de la caña Kavangire en Puerto Rico. (Kavangerie cane importation into Puerto Rico.) Mundo Azucarero **14**(5): 145–149, 1926. (Planter & Sugar Manuf. **77**: 327–330, 1926.)

Controversial.

The P.O.J. 979 variety in Tucumán. The Planter & Sugar Manuf. **78**(1): 8, 1927.

Cruz, Francisco & Bruner, Stephen C[ole.]

Una visita de inspección a la zona de tabaco en Cabaiguan. (An inspection of the tobacco region of Cabaiguan.) Rev. Agric. Comercio y Trab. Cuba **13**(10): 34–38, 1931.

A variety known as Puerto Rico which is probably *Nicotina lanceolata* is very susceptible to mosaic. A small planting of *N. havanensis* was almost free from the disease.

Cubillos, Luis A.

Cafetos enfermos. (Diseased coffee trees.) Rev. Cafetera de Colombia **2**(10): 323–324, 1929.

Brief note in which the author states that root lesions caused by implement and over production may determine the causes of the diseases which were under observations.

Cunningham, H. S.

Report of Plant Pathologist. Rept. Dept. Agric. Bermuda. For the year **1928**: 26–28, 1929.

Records *Cercospora musarum* (Black tip of banana) and *Septoria* blight of celery, *Cerotelium fici* of figs, *Alternaria solani* of potatoes, *Septoria* of tomato.

Report of the plant pathologist. Bermuda Dept. Agric. **1929**: 26–31, 1930.

Report of the plant pathologist. Bermuda Dept. Agric. Ann. Rpt. **1930**: 33–39, 1931.

Curruthers, J. B.

Cacao canker. Bull. Dept. Agric. Trinidad **9**(64): 30–31, 1910.

Dalbey, Nora E[lizabeth]

Corn disease caused by *Phyllachora graminis*. Phytopathology **7**(1): 55–57, 1917.

Phyllachora as the cause of a disease of corn, and a general consideration of the genus *Phyllachora*. Trans. Ill. Acad. Sci. **10**: 230–248, 1917.

Dalmau, Luz María

Observations on mycologic technique with particular reference to pathogenic fungi. Puerto Rico. Journ. Pub. Health. **5** (3): 302, 1929.

Damph, Alfonse

No existe en México el mal de Panama del plátano. (The Panama disease of the Plantain does not exist in México.) Bol. Mens. Ofic. Def. Agric. Estados Unidos Mexicanos. **2** (10–11): 638–642, 1928.

Bibliografía de los principales trabajos relativos al mosaico de la caña de azúcar que se han publicado a partir del descubrimiento de la enfermedad hasta el año 1929. (Bibliography of the leading articles related to sugar-cane mosaic published from the discovery of the disease to the year 1929.) Bol. Mes. (México) Oficina Federal Defensa Agric. **3**(5–8): 186–236, 1929.

México: Panama disease of bananas. Int. Bull. Plant Proct. **6** (2): 24, 1932.

The disease is reported in the State of Tamaulipas. The organism is given as *Fusarium cubense* var. *inodoratum (F. oxysporum)*.

Dash, J. Sydney

Report on the entomological and mycological work. Banana. Barbados Dept. Agric. Rept. **1913–14**: 43–45, 1915.

Wilt disease of sugar cane. Barbados Dept. Agric. Ann. Rpt. **1915–1916**, 1916.

Diseases of musaceous crops. Brit. Guiana Sci. & Agric. Rpt. **1927**: 5–7, 1927.

Davidson, Ross W[allace]

Notes on tropical rusts with descriptions of two species. Mycologia **24**(2): 221–228, 1932.

Description or mention of 14 species.

Davis, Robert L[esley]

P.O.J. 2878 in Puerto Rico. Sugar News. **10**(5): 342–343, 1929.

Studies on mosaic.

Java–Barbados hybrids in Porto Rico. Planters & Sugar Manuf. **83**(5): 83–85, 100; (6): 103–104; (7): 123–125, 1929. (Rev. Appl. Mycol. **9**(2): 132, 1930.)

Studies of varieties of sugar cane resistant to mosaic.

Mayagüez 3, 7 and 42—Three cane varieties immune to mosaic. Puerto Rico Agric. Expt. Sta. Notes **52**, 2 p., 1930.

The three varieties Mayagüez 3, 7 and 42 produced from crossing POJ 2725 and SC 12(4) appeared to be resistant to mosaic.

Report of the Plant Breeder. Porto Rico Agric. Expt. Sta. Rpt. **1931**: 13–22, 1932.

Mayagüez 28, 49 and 63, three sugar-cane varieties commercially resistant to mosaic. Porto Rico Agric. Expt. Sta. Notes **61**, 6 p., 1932.

A report on the behavior of these and other varieties.

Sugar-cane crosses with Kassoer, selfs. Trans. Fourth Intern. Congress Soc. Sugar-Cane Tech. 1932. (Facts About Sugar (Abstract) **27**(5): 218, 1932.

Tests with crosses of Kassoer to determine susceptibility to mosaic disease of sugar cane.

Sugar-cane seedling mosaic elimination. Trans. Fourth Intern. Congress Soc. Sugar-Cane Tech. 1932. (Facts About Sugar (Abstract) **27**(5): 219, 1932.)

Experiments to determine the optimum spacing and planting methods for obtaining data on the reaction of sugar-cane seedling to mosaic. Under Mayagüez (Puerto Rico) conditions, it was found that mosaic will spread in 8 months for a distance of 50 feet along a single row of a susceptible variety.

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Instrucciones para la eradicación de la enfermedad de la caña. (Instructions for the sugar-cane disease eradications.) Ins. Expt. Sta. Puerto Rico Circ. **14**: 6–8, 1918.

Recommends the planting of healthy canes and roguing.

Informe leído ante la Asociación de Productores de Azúcar de Puerto Rico. (Report read before the Sugar Producers' Association of Puerto Rico.) Rev. Agric. Puerto Rico **2**(1): 5–10, 1918.

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The Year's experience with sugar-cane mosaic or yellow stripe disease. Journ. Dept. Agric. Puerto Rico **3**(4): 3–33, 1919.

Gives the results of field studies for control.

The resistance of cane varieties to the yellow stripe disease. Ins. Expt. Sta. Puerto Rico Bull. **19**, 19 p., 1919.

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The yellow stripe disease of sugar cane. Ins. Expt. Sta. Puerto Rico Ann. Rpt. **1918–19**: 18, 1919.

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A brief popular discussion.

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The mosaic or new sugar-cane disease. Louisiana Plant. & Sugar Manuf. **63**: 167, 1919.

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Sugar-cane root disease. Journ. Dept. Agric. Porto Rico **4**(1): 3–27, 1920.

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Review of the work done in the Island to eradicate the disease.

La extirpación del mosaico. (Mosaic eradication.) Sugar **23**: 114–115, 1921.

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Mosaic disease danger. Prompt action needed to stop its spread in Cuba. Facts About Sugar **16**: 230–231, 1923.

The disease is spreading rapidly in Cuba and very little is being done to control it.

Sugar-cane root diseases. A neglected enemy of cane and ways of controlling it. Facts About Sugar. **16**: 314, 1923.

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Sugar-cane root diseases. The greatest cause of loss to the cane growing industry—means of prevention. Facts About Sugar. **20**(37): 882, 1925.

A statement of opinion.

Mosaic eradication urged. (Urge la extirpación del matizado.) Facts About Sugar **19**(11): 253, 1923. (Rev. Agric. Puerto Rico **13**(4): 249–250. Australian Sugar Journ. **16**(3): 615–616, 1925.)

Sugar-cane mosaic and sugar-cane chlorosis. Facts About Sugar. **19**(16): 372, 1924.

A discussion of the characters of true mosaic and chlorosis.

Kavangerie in Porto Rico. (A reply to D. W. May.) Facts About Sugar **21**: 925–927, 1926.

Controversy.

Sugar cane and its culture. New York, 355 p., 1928.

Discusses sugar cane diseases on pages 109–161; specially on the area covered by this work.

Sugar-cane varieties in Cuba. Planter and Sugar Manuf. **81** (19): 361–362; (20): 383–385; (21): 404–405, 439; (22): 424–425; (23): 443–445, 459–460; (24): 462–464; (25): 482–484, 1928.

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Immunity to sugar-cane mosaic acquired by the host. Proc. Nat. Acad. Sci. U.S.A. **17**(6): 331–334, 1931.

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A report on the sugar mosaic situation in February, 1924, at Soledad, Cuba. Harvard Inst. Trop. Biol. & Med., Contrib. **1**, 52 p., 1925. (Rev. Appl. Mycol. **5**(10): 582–583, 1926.)

A statement of the purpose of this journey and a discussion of the mosaic at Soledad, Cuba.

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Central American Pyrenomycetes. Iowa Univ. Bull. **2**: 395–415, 1893.

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Nicaraguan Hymenomycetes. Iowa Univ. Bull. Lab. Nat. Hist. 3(4) : 190–194, 1896.

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The ascocarpic stage of species of *Scopulariopsis*. Mycologia **23** (5) : 313–329, 1931.

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Myxomyceten aus Mexico. (Myxomycetes from Mexico.) Bot. Mag. Japan **47** : 132–135, 1933.

Ernst, Adolfo
Candelilla ein Krankheit des Kaffeebaumes. ("Candelilla" a disease of the coffee tree.) Bot. Zeti. Regensburg, **34** : 33–41, 1876.

Estudios sobre las deformaciones, enfermedades y enemigos del árbol de café en Venezuela. (Studies on the deformations, diseases and enemies of the coffee in Venezuela.) Bol. Cámara de Comercio de Caracas, **120**, 31 p., 1877.

This paper won a prize in a contest and contains notes by Dr. H. Pittier. The author believes that coffee is not a suitable crop for Venezuela due to adverse climatic and soil conditions and especially external agents such as diseases, animal and plant parasites.

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Coffee diseases in New Granada. Nature **23** : 292, 1880.

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La epizootía de las moscas (*Empusa muscae*). (The epizooty of the flies.) La Opinión Nacional, Caracas, julio 15, 1880.

Hongos parásitos del árbol de café. (Parasitic fungi of the coffee tree.) La Opinión Nacional, Caracas, octubre 12, 1880.

Las familias más importantes del reino vegetal especialmente las que son de interés en la medicina, la agricultura e industria, o que están representadas en la flora de Venezuela. (The most important families of the vegetable kindom specially those of interest in medicine, agriculture and industry, or those represented in the Flora of Venezuela.) Caracas, 80 p., 1881.

Observaciones sobre la enfermedad de los pececillos. (Observations on the gold fish disease.) La Opinión Nacional, Caracas, diciembre 24, 1885.

El tizón del maíz. (Corn smut.) Bol. Min. Obras Pub. Caracas, diciembre 26, 1891.

Hongos parásitos del árbol de café. (Parasitic fungi of the coffee tree.) Bol. Min. Obras Pub. Caracas, 1892.

Estudios nesológicos del cafeto. (Studies on coffee diseases.) Rev. Cafetera de Colombia **4**(42–43): 1553–1554, 1932.

Brief notes on the following topics: Coffee tree deformations, abnormal arrangement of lateral organs, leaf irregularity, abortion of one of the grains in the berry, pea berries and adherance of the fruit.

Espinosa Bustos, Marcial R.

Sobre las especies chilenas del género *Fomes*. (On the Chilean species of the genus *Fomes*.) Rev. Chilena Hist. Nat. **25** (1921): 231–243, 1923.

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Contribución al conocimiento de los hongos chilenos. (Contribution to the knowledge of the Chilean fungi.) Bul. Mus. Nac. Chile **9**: 65–94, 1916; **12**: 127–138, 1929.

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The Panama disease. Preliminary notice. Ann. Botany **24**: 488–489, 1910.

Brief note. Believes that Panama disease is due to *Ustilagineae*.

The Panama disease I. Ann. Botany. **25**(98): 343–352, 1911.

The author believes that the disease is caused by *Ustilaginoidella musaeperda*.

The Panama disease II. Ann. Bot. **25**: 353–361, 1911.

The author says—"I have convincingly proved that this disease, as it occurs in Suriname is caused by the *Ustilaginoidella musaeperda*." He describes the organism.

The Surinam disease. A condition of Elephantiasis of the banana caused by *Ustilaginoidelle oedipigera*. Ann. Bot. **25**: 363–365, 1911.

The author believes that the disease is due to *Ustilaginoidella musaeperda*. One symptom is "bigie toe" or Elephantiasis.

Cacao canker. West Indian Bull. **12**: 302–308, 1912.
A description of the disease which is attributed to *Spicaria colorans.*

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Lichens and Bryophytes at Cinchona. Science **43**: 918, 1916.

Fairman, Charles E.
Notes on new species of fungi from various localities. Mycologia **5**(4) : 245–248, 1913.

Fantini, Nicolás
La antracnosis y medios de curación. (Anthracnose and its cure.) Defensa Agric. (Uruguay) **1**: 179–180, 1920.
Popular discussion of antharcnose caused by *Gloeosporium ampelophagum.*

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El mosaico de la caña de azúcar. Historía de esta enfermedad en la caña Dominicana. (Sugar-Cane mosaic. History of this disease in the Dominican Republic.) Rev. Agric. Santo Domingo **17**: 73–76, 90–95, 105–108, 1922. (Rev. Appl. Mycol. **3**: 437, 1923.)
A popular discussion of the disease and suggestions for the use of resistant varieties for control.

Cold chlorosis of sugar cane. Trop. Plant Res. Found., Sci. Con. No. **3**. 1926 (Phytopathology **16**(11) : 885–891, 1926.)
A description of this disease which is due to low temperature.

Some serious sugar-cane diseases not known to occur in Cuba. Trop. Plant Res. Found. Bull. **4**, 22 p., 1926.
The author describes and discusses Sereh, Fiji, downy mildew, gummosis, leaf scald, dry top rot, smut, and cane rust.

Proc. 2nd. Int. Conf. Sugar-Cane Technologist, Havana, p. 99–100, 1927.

Field control of sugar-cane root disease conditions. Trop. Plant Res. Found. Bull. **6**, 16, p., 1927.
A discussion of methods of improving the environment.

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Sugar-cane root disease in Cuba: A progress report upon the root disease situation in 1925. Phytopathology **17**(2) : 61–82, 1927.
A description of symptoms and the results of inoculation studies which were negative. The most important factor appears to be poor drainage.

Zonate foot rot of sugar cane. Phytopathology **17**(2) : 83–94, 1927.

Description of a disease which appears to be due to a *Fomes*.

Use of poor seed cane in Cuba. Facts About Sugar **22**(35) : 845, 1927.

Popular.

Some sugar-cane leaf spots in Cuba. Notes on observations of certain affections of canes, including two believed to be new to science. Facts About Sugar **22**(49) : 1183–1184, 1927.

Popular.

Brown stripe of sugar cane in Cuba. Phytopathology (Abstract) **18**(1) : 135, 1928.

Attributes this disease to *Helminthosporium stenospilum* n. sp.

Sugar-cane eye spot in Cuba Phytopathology (Abstract) **18**(1) : 135, 1928.

Three *Helminthosporium* diseases of sugar cane. Phytopathology **18**(9) : 753–774, 1928.

Says that *H. sacchari* is not the cause of the eye spot in Cuba but that the disease is caused by a new species *H. ocellum*. Also describes a new disease, the brown stripe which he attributes to a new species. *H. stenospilum.*

Informe sobre algunas enfermedades menores de la variedad de caña POJ–2878 en Cuba. (Some minor diseases of the POJ–2878 cane variety in Cuba.) Memoria. Conferencia Ann. Assoc. Tec. Azucr. Cuba **3**: 92–105 (Spanish: 84–98), 1929.

A discussion of mosaic, nutritional chlorosis, stem galls and abnormal buds.

Field control of sugar-cane mosaic in Cuba. The Reference Book of the Sugar Industry of the World, **7**:32–35, 1929.

A popular discussion with a great deal of yield data concerning Cuban conditions.

Some pathological effects of the mosaic disease of sugar cane. Planter & Sugar Manuf. **82**(21) : 404–405, 1929.

El dominio del mosaico de la caña de azúcar en el campo Cubano.. (The range of mosaic of sugar cane in Cuban plantations.) Bol. Unión Panamericana **64**(9) : 968–983, 1930.

The author gives three marked zones that occur in Cuba in regard to the spread of the disease. Gives the varieties best adapted to each zone and in each season.

The utilization of varieties in the field control of sugar-cane mosaic and root disease in Cuba. (A preliminary report.) Trop. Plant. Res. Found. Sci. Contr. **20**, 69 p., 1931.

The author gives a large amount of data demonstrating that the use of resistant varieties is the most satisfactory method for the control of this disease.

Fawcett G[eorge] L[orenzo]

Report of the plant pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1908**: 35–37, 1909.

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Report of the Plant Pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1913**: 26–29, 1914.

Eight Ann. Rpt. Proc. Cuban Nat. Hort. Soc., p. 21–30, 1914.

Pellicularia Koleroga on Coffee in Puerto Rico. Journ. Agric. Res. **2**(3) : 231–233, 1914.

Discussion of a coffee leaf disease caused by the fungus *Pellicularia Koleroga* not described before from Puerto Rico. The author believes that this is a different disease from the one called ''Candelilla'' in Venezuela and attributed to the same fungus.

Apuntes botánicos y micológicos. Las enfermedades de las raíces de la caña. (Botanical and mycological notes. Cane root diseases.) Rev. Indus. Agric. (Tucumán) **6**(1) : 37–38, 1915.

Brief popular notes on *Marasmius sacchari* and nematodes.

A Puerto Rican disease of bananas. Puerto Rico Agrci. Expt. Sta. Ann. Rpt. **1915**: 36–41, 1916.

Enfermedad del cacao. (Cacao disease.) Rev. Indus. y Agric. (Tucumán) **10**: 52–54, 1920.

A disease reported from Ecuador and apparently due to *Phytophthora faberi.*

Notas preliminares sobre una enfermedad del tabaco. (A preliminary note on a tobacco disease.) Rev. Indus. y Agric. (Tucumán). **12**(1–2): 5–17, 1921.

The disease is caused by *Bacillus solanacearum.*

La gomosis de los naranjos. (Gommosis of orange trees.) Rev. Indus. y Agric. (Tucumán) **12**(11–12): 149–155, 1922.

A semi-popular paper discussing two forms of the disease. The causes are *Phytophthora terrestria.* (*P. parasitica*), *Diplodia* sp. and a *Fusarium* which is a form of *Nectaria hematochronia.*

Report of the Plant Pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1914**: 27–30, 1915.

Enfermedades del café causadas por hongos. (Fungous diseases of coffee in Puerto Rico.) Puerto Rico Agric. Expt. Sta. Bull. **17**, 31 p., 1916.

General account of the most prevalent fungous diseases in Puerto Rico. Gives description of symptoms, and of the causal organisms and methods of control.

Una enfermedad de la caña producida por condiciones desfavorables de clima y suelo. (A sugar-cane disease caused by unfavorable climatic and soil conditions.) Rev. Indus. Agric. (Tucumán) **8**(5–6): 136–140, 1917.

The author refers to mosaic diseases and attributed it to unfavorable conditions of soil and climate.

La enfermedad de las rayas amarillas de la caña. (Yellow stripe disease of sugar cane.) Rev. Indus. Agric. Tucumán **10**–46–48, 1919.

The disease is widely distributed on the Java varieties. Kavangerie is immune and D–1135 is resistant.

La verruga o "scab" de las citrus (Citrus scab), Rev. Indus. Agric. (Tucumán), **10**(7–8): 124–128, 1920.

Popular account describing the disease and giving methods of control.

Notas sobre la extirpación del mosaico de la caña. (Notes on sugar-cane mosaic eradication.) Rev. Indus. Agric. (Tucumán) **11**(5–6): 74–76, 1920.

The yellow stripe or mosaic disease in Argentina. Louisiana Planter & Sugar Manuf. 64: 41, 1920.

Reports the disease as having been in Argentina for 15 years or more. It is abundant but not serious.

Enfermedades de la caña de Azúcar en (Tucumán). (Diseases of sugar-cane in Tucumán) Bol. Estac. Expt. Agri. (Tucumán) **13**(1–2) : 1–46, 1922.

Describes a top rot or polvillo from which he isolated *Bacillus flavidus* n. sp. Mosaic is common. Reports *Acrostalagmus glaucus* n. sp. *Cytospora sacchari, Melanconium sacchari, Fusarium* sp. *Acrostalagmus sacchari, Colletotrichum falcatum, Leptosphaeria sacchari, Phyllosticta sacchari, Marasmius sacchari.*

Las enfermedades de la caña de azúcar en Tucumán. (Diseases of sugar-cane in (Tucumán) Estac. Expt. Agri. (Tucumán) Bol. **1**, 47 p., 1924.

The author mentions dry bud rot, mosaic, sprout rot, yellow sprout, rind disease, common leaf spot, long leaf spot and root disease.

La transmisión del mosaico. (The transmission of mosaic.) Sugar **25**: 684, 1923. (Rev. Indus. Agric. (Tucumán) **13**(7–8) : 129–131, 1923. (Rev. Appl. Mycol. **3**: 367–368, 1924.)

A review of the work of Brandes and other on insect transmission.

La desinfección de la caña por la calefacción. (Sugar cane desinfection by heat.) Rev. Indus. Agric. (Tucumán) **13**(11–12) : 105–206, 1923.

This paper gives the results of attempts to control mosaic by treatment with hot water. The results were negative.

El mosaico de là caña de azúcar. (The mosaic of sugar cane.) Rev. Indus. Agric. (Tucumán) **14**(1–2) : 6–8, 1923. (Rev. Appl. Mycol. **3**: 485, 1924.)

A popular discussion of the subject.

El mosaico o enfermedad de las rayas amarillas de la caña. (Mosaic or yellow stripe disease of the sugar cane.) Rev. Indus. Agric. Tucumán **15**(7–8) : 103–111, 1925. (Rev. Agric. Com. & Trab. Cuba **8**(1) : 23–29, 1926.)

A popular discussion of the mosaic including information on vectors and method of control.

La desinfección de la caña. (Sugar-cane disinfection.) Sugar **27**(1) : 53, 1925.

A popular review of Dr. Wilbrink's hot-water treatment of cane.

Encrespamiento de las hojas de la remolacha azucarera. (Leaf curl of the sugar beet.) Rev. Indus. Agric. (Tucumán) **26** (3–4) : 39–46, 1925.

Sugar beets of Argentine are attacked by a disease called "Encrespamiento" which is different from curly top. It is carried by a leaf-hopper, *Aceratogallia sanguinolenta.*

Departamento de botánica y patología vegetal. (Department of Botany and plant pathology.) Rev. Indus. Agric. (Tucumán) **19**(9–10) : 207–209, 1927.

Notes on curly top of sugar beets.

The curly top of sugar beet in Argentina. Phytopathology **17** (6) : 407–408, 1927.

Agallia stricticollis Stal. transmits the disease.

El encrespamiento de las hojas de la remolacha y el insecto trasmisor. (The curling of the leaves of the beet and the insect vector.) Rev. Indus. Agric. (Tucumán). **18**(5–6) : 61–66, 1927.

Popular discussion.

La gomosis o pie podrido de los naranjos. (Gummosis or foot rot of oranges.) Rev. Indus. Agric. (Tucumán). **17** : 166–171, 1927.

A brief description of the disease with recommendations for its control. The author believes there is some causal agent other than *Phytophthora parasitica.*

Las manchas blancas de las hojas de la caña. (White spots of sugar-cane leaves.) Rev. Indus. Agric. (Tucumán) : **17** : 259–261, 1927.

A description of the disease.

El enrojecimiento de las hojas de algunas variedades de caña de azúcar. (The reddening of the leaves of certain sugar-cane varieties.) Rev. Indus. Agric. (Tucumán). **19**(3–4) : 104–105, 1928.

The disease is not considered important.

Apuntes sobre el mosaico de la caña de azúcar. (Notes on mosaic of sugar cane.) Rev. Indus. Agric. (Tucumán) **18**(11–12) : 205–209, 1928. (Rev. Appl. Mycol. **7** : 743, 1928.)

A discussion of varieties not completely immune to mosaic.

Departamento de Botánica y Patología Vegetal. (Department of Botany and Plant Pathology.) Rev. Indus. Agric. (Tucu-

mán) **18**(9–10): 172–174, 1928. (Rev. Appl. Mycol. **7**: 562, 1928.)

Notes on different virus diseases of economic plants. Mosaic is the only important disease. Given the results of tests of P.O.J. 2725.

La clorosis de la caña recién brotada. (Chlorosis of recently sprouted cane.) Rev. Indus. Agric. (Tucumán) **19**(7–8): 214–215, 1929.

El cultivo y las plagas del tabaco. (The cultivation and plagues of tobacco.) Rev. Indus. Agric. (Tucumán) **19**(7–8): 215–216–1929.

A brief note.

Manera de determinar los lugares infestados por la enfermedad del ananás de caña de azúcar. (Mode of determining the field spots infested by the pineapple disease of sugar cane.) Rev. Indus. Agric. (Tucumán). **19**(7–8): 213–214, 1929.

Refers to *Thielaviopsis paradoxa.*

Plaga de los alfalfares. (Pest on alfalfa.) Rev. Indus. Agric. (Tucumán) **19**(7–8): 215, 1929.

Notes on *Rhizoctonia violacea* on alfalfa.

El enruliamento, de las hojas de la tomatera. (Curly top of the tomato.) Rev. Indus. Agric. (Tucumán) **20**(3–4): 49–54, 1930. (Rev. Appl. Mycol. **9**: 565, 1930.)

The author refers to this disease as curly top of the tomato in Argentine which is due to the same virus as the curly top of the sugar beet and is known in California as the western yellow blight of tomato. It is transmitted by *Agallia stricticollis.*

Las plantaciones de caña sin mosaico en Tucumán. (The cane plantations free from mosaic in Tucumán.) Rev. Indus. Agric. (Tucumán) **21**: 126–127, 1931.

Report of the negative results obtained in Argentine by the roguing method for eradication of sugar-cane mosaic.

La pudrición negra de la caña de azúcar (*Thielaviopsis*). (The black-rot of sugar cane (*Thielaviopsis*) Rev. Indus. Agric. (Tucumán). **21**(3–4): 55–59, 1931.

La verrucosis de los "Citrus" Est. Exp. Agric. Tucumán. Circ. **26**: 1–6, 1931.

Brief description and recommendations for the control of citrus scab. (*Sphaceloma*)

Departamento de Botánica y Patología Vegetal. (Department of Botany and Plant Pathology.) Rev. Indus. Agric. (Tucumán). **22**(1–2): 31–34, 1932.

Reports *Cephalosporium sacchari* on sugar cane.

Las rayas blancas de las hojas de la caña de azúcar. (The white stripes of sugar-cane leave.) Rev. Indus. Agric. (Tucumán) **22**(11–12): 299–302, 1932.

May be due to low temperature.

Notas sobre las enfermedades de la caña de azúcar. (Notes on sugar-cane diseases.) Rev. Indus. Agric. (Tucumán). **23** (3–4): 68–69, 1933.

Departamento de Botánica y Pathología Vegetal. (Department of Botany and Plant Pathology.) Ex Memoria Anual del año 1932. (Annual Report for the year 1932.) Rev. Indus. Agric. (Tucumán) **23**(11–12): 243–247, 1933.

Some discussions of sugar-cane disease. Also mentions a disease of Citrus in Paraguay that resembles canker. (*Pseudomonas citri.*)

La fumagina de la caña de azúcar de Santa Fé y Corrientes. (Sooty mould of sugar cane in Santa Fé and Corrientes.) Rev. Indus. Agric. (Tucumán) **24**(7–8): 165–167, 1934.

Account of this minor sugar-cane fungus.

Clave para la determinación de las variedades de caña de azúcar cultivadas en Tucumán. (Key for the determination of the sugar cane varieties cultivated in Tucumán.) Tucumán (Argentine) Agric. Expt. Sta. Circ. **44**: 81–94, 1935.

This is a supplementary work to circular 36 of the same series. In this work the reaction to mosaic disease is included as a character for the determination of the sugar-cane varieties.

Una nueva enfermedad del arroz en Tucumán: la brusone (*Piricularia Oryzea*). A new rice disease in Tucumán: blast (*Piricularia Oryzae*) Tucumán (Argentine) Estac. Expt. Agric. Circ. **42**, 6 p., 1935.

Account of the first report of rice blast caused by the fungus *Piricularia Oryzae* in Argentine. Control measures are suggested.

Notas sobre nuevas plagas del arroz en Tucumán. (Notes on new rice pests in Tucumán. Tucumán Ext. Expt. Agric. (Argentine) Circ. **45**, 3 p., 1935.

Report of a new disease of rice (*Entyloma Oryzae*) and description of symptoms.

Sobre algunas enfermedades del algodonero. (On some cotton diseases.) Est. Expt. Agron. Tucumán (Argentina) Circ. **52**, 8 p., 1936.

Popular notes discussing angular leaf spot (*Pseudomonas malvacearum* E.F.S.) Circular spot (*Cercospora gossypina* Cke.); root diseases, mechanical injuries and diseases that may be introduced.

Fawcett, H[oward] S[amuel]

Citrus diseases of Florida and Cuba compared with those of California. California Agric. Expt. Sta. Bull. **262**: 153–210, 1915.

————————, **& Lee, H[enry] Atherton.**

Citrus diseases and control. Mc Graw-Hill Book Company, New York, 582. p., 1926. 2d. Ed. 1936.

A most thorough discussion of all known diseases of citrus.

Fawcett, William

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Dr. Burck's method of treatment of the coffee-leaf disease in Java. Bull. Bot. Dept. Jamaica. **22**: 3–10, 1891.

Review of paper by Dr. Burck on the treatment of coffee against *Hemileia vastatrix.*

Includes popular notes on this fungus and gives warning to growers about this dreadful oriental disease of coffee. Includes government rullings.

Report on the coconut disease at Montego Bay. **Botanical Dept.** Jamaica, Bull. **23**, 2 p., 1891.

Report on the Cayman Islands. Botanical Dept. of Jamaica. **11**: 3–4, 1889.

(Director of Public Gardens & Plantations.) Report on Diseases in Sugar Cane. Society paper No. **27**. (Proc. Agric. Soc. of Trinidad **1**: 184–189, 1894.)

Popular. Mentions *Colletotrichum falcatum, Trichosphaeria sacchari,* root fungus, rind disease and nematodes. The Bourbon cane was exterminated.

The prevention of the introduction and spread of fungoid and insect pests in the West Indies. West Indian Bull. (Barbados) **1**(1): 108–113, 1899.

————————, **& Rendle, A. B.**

Citrus.—Flora of Jamaica. **14**(2): 183–190, 1920.

Ferdinandsen, C[arl Christian Frederik], & Winge, O[jvind]

(Fungi from the Danish West Indies collected by C. Raunkiaër.) Bot. Tidsk **29**: 1–25, 1909.

(Fungi from Prof. Warming's expedition to Venezuela and the West Indies.) Bot. Tidrskrift **30**: 208–222, 1910.

Fernandes e Silva, R.

A podridao preta e a podridao peduncular dos Citrus. (Black rot and stem end rot of Citrus.) Bol. Minist. Agric. Río de Janeiro **24**(10–12): 12–24, 1935.

The author reports black (*Diplodia natalensis*) and stem end rot (*Phomopsis (Diaporthe) Citri*) occurring in Brazil on citrus fruits. The author reviews the outstanding work on these diseases and their control by various well known American phytopathologist.

Fernández, D. S. & Dijk, J. W. van

De intervimgsziekte bij de cacao. Bandbouco Proefst. Suriname, Meded **1**, 47 p., 1926.

Fernow, K[arl] H[ermann]

Potato growing in Bermuda. Amer. Potato Journ. **8**(6): 150–153, 1931.

Leaf-roll potato plants give no yield in Bermuda.

Figueroa, C[arlos] A[rturo]

The mottling disease of cane and the sugar production of Puerto Rico. Journ. Dept. Agric. Puerto Rico. **3**(4): 35–43, 1919.

A statistical study to determine the extent of the losses.

Filho, A. F. O.

O cambate contra o "mosaico" da canna d assucar. (The fight against the "mosaic" of sugar cane.) Brasil Agric. **12**: 65–70, 1927.

Fink, Bruce

The distribution of fungi in Puerto Rico. Mycologia **10**(2): 58–61, 1918.

New species of lichens from Puerto Rico. I. Graphidaceae. Mycologia **19**(4): 206–221, 1927.

Ficher, Edward

Phalloideen aus Surinam. (Phaloides from Surinam.) Ann. Mycol. **25**: 470–473, 1927.

Untersuchungun über phalloidean aus Surinam. (Investigations on the phaloïdes of Surinam.) Naturf. Ges. Zürich **73**: 1–39, 1928.

Fischer, Gustavo J.

Observaciones sobre el rendimiento, la precocidad y la resistencia a la *Puccinia triticina* del trigo 38 M. A. (Observations

on yield, precocity and resistence to *Puccinia triticina* of the wheat 38 M. A.). Nuestra Chacra **4**(23) : 17–20, 1929.

As its title implies these are experimental observations on disease resistance breeding experiments.

Fitzpatrick, Henry Morton

Rostronitschkia, a new genus of Pyrenomycetes. Mycologia **11** (4) : 162–167, 1919.

Monograph of the Coryneliaceae. Mycologia **12**(4) : 206–267, 1920.

Monograph of the Nitschkieae. Mycologia **15**(1) : 23–67, 1923.

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A mycological survey of Puerto Rico and the Virgin Islands. Mycologia **19**(3) : 144–149, 1927.

A review.

The lower fungi. Phycomycetes. Mc Graw-Hill, New York, 331 p., 1930.

Fox, Alvin

Nut fall and leaf-drop of coconut-palms in Cuba. Cuba Rev. **17**(1) : 12–15, 1918.

Brief notes on *Phytophthora.*

Fredholm, A[dolf]

Fungi considered from an economic standpoint. Soc. paper 335. Proc. Agric. Soc. of Trinidad. **8** : 393–400, 443–455, 1905.

Popular discussion including a classification.

Maize or corn blight. Soc. paper 469. Proc. Agric. Soc. of Trinidad and Tobago. **11** : 354–355, 1911.

Popular discussion of *Ustilago maydis.*

A possible inference to be drawn from the study on cacao canker. West Indian Bull. **12**(3) : 308–310, 1912. (Trinidad & Tobago Dept. Agric. Bull. **11**(70) : 46–48, 1912.)

Popular.

Diplodia disease of the coconut palm. Society Paper **367**. **Agric.** Soc. of Trinidad & Tobago **9**(3) : 159–172, 1909.

A very complete discussion of the disease. Caused by a *Diplodia* which may be same as the *Botryodiplodia* of Stockdate (See coconut-palm diseases in Trinidad) or with *Diplodia epicocos* Cooke.

Freeman, W[illiam] G[eorge]

Sugar-cane mosaic. Trinidad & Tobago. Administration Report of the Director of Agric. 1922, 12 pp., 1923.

Refers to a campaign for the eradication of mosaic.

Sugar-cane mosaic. Administration Report of the Director of Agriculture of the Dept. of Agric. Trinidad & Tobago, **1921**, 12 p., 1922. (Rev. Appl. Mycol. **2**: 394, 1923.)

Refers to a campaign for the eradication of mosaic.

An algal disease of cacao. Trinidad & Tobago Dept. Agric. Bull. **13**(83): 263–264, 1914.

Plant pests and diseases. Trinidad & Tobago Dept. Agric. Report p., 31–33, 1925.

Witch broom in Trinidad. Trop. Agric. (Trinidad) **5**(11): 287, 288, 1928.

A description of the disease which the author attributes to *Marasmius perniciosus.*

Lime cultivation. Diseases and pests. Soc. paper 610. Proc. Agric. Soc. of Trinidad. **15**: 12–13, 1915.

Popular abstract of an address.

————, & **Briton–Jones, H. R.**

Witch-broom disease. A reply to criticisms. Trop. Agric. (Trinidad) **6**(2): 55–56, 1929.

Refers to *Marasmius pernicious.*

Freise, C. V.

Contribuicao as estudio histologico dos cafeeiros no Brazil (Cont.) D.N.C. Rev. (Río de Janeiro) **1935**(2): 829–831, 1935.

Fresa, R.

Argentine Republic: *Melampsora larici-populina* in the Delta of Paraná. Int. Bull. Plant Prot. **10**(7): 145–146, 1936.

Popular. Rust caused by the fungus *Melampsora larici-populina* is reported to have developed with great intensity on *Populus nigra* var. *italica* in the Delta of Paraná, this being the first record of its occurrence in the Argentine. Description of symptoms are given as well as associated organisms.

Freise, F[riedrich] W.

Cane diseases and plagues in Brazil. Mosaic, sereh, iliau diseases and gummosis are the most prevalent—low yield attributed largely to losses caused by these agents. Facts About Sugar **25**(24): 613–614, 1930.

A popular discussion of cane diseases in Brazil.

Fries, Robert Elias

Myxomycetes von Argentinien und Bolivia. Arkiv. Bot. **1**: 57–70, 1903.

Über einige Gasteromyceten aus Bolivia und Argentinien von Rob. Fries. Arkiv. Bot. **8**(11): 1–34, 1909.

Die Myxomyceten des Juan Fernández-Islen. In: Skottsberg, C. The Natural History of Juan Fernández and Eastern Island. V. II. Botany pt. 1., Uppsala, 1920.

Fries, Thore C.

Die Gasteromyceten des Juan Fernández-und Osterinseln. In Skottsberg, C. The Natural History of Juan Fernández and Eastern Islands. V. II. Botany Part 2, Uppsala, p. 59–60, 1922.

Forsyth, W. J.

King coffee, a new coffee-leaf disease developed in Soconnusco Chipas, México. New Iberia Exterprise, **21**, 1896. (Trop. Agric. (Ceylon) **16**: 549–550, 1897.)

The author reports his observation in the coffee groves affected by the maladies.

Coffee planting in México; Coffee-leaf disease in Chiapas, México. Trop. Agric. (Ceylon) **16**: 629–631, 1897.

Fortún Martínez, Gonzalo & Bruner, Stephen C[ole.]

Investigaciones sobre la enfermedad del mosaico o rayas amarillas de la caña de azúcar. (Investigations on mosaic or yellow stripe disease of sugar cane.) Rev. Agric. Comm. & Trab. Cuba **3**: 441–445, 1921.

The results of a field test with 52 varieties of cane to determine resistance and susceptibility.

El mosaic o rayas amarillas de la caña de azúcar. (The mosaic or yellow stripe of sugar cane.) Rev. Agric. Com. & Trab. Cuba **6**(1): 4–8, 1924.

¿Cuál es el origen del matizado en Cuba? (What is the origin of mottling in Cuba?) Rev. Azucarera (Argentina) No. **374**: 1089, 1924.

Furtado, C. X.

Coconut tapering disease. Trop. Agric. (Ceylon) **61**(2): 126, 1923.

A discussion.

Gaillard, A.

Le genere *Meliola* Paris, 163 p., 1892.

Gándara, G.

Los nematodos del cafeto. (Coffee nematode.) Com. Par. Agric. (México) Circ. **51**, 7 p., n. d.

Description of the nematode *Heterodera radicicola* and its effects on the coffee tree. He gives methods of control. Among the substances suggested to fight this pest he mentioned gasoline, benzine, copper sulfate, carbon bisulfate and potasium sulfocarbonate.

Enfermedades y plagas del naranjo. Est. Agric. Central, México, Bol. **111**, 40 p., 1920.

Gandía Córdova, Ramón

La enfermedad de la caña. (The sugar cane disease.) Rev. Agric. Puerto Rico **3**(1) : 63, 1919.

Popular account discussing the occurrence of the disease in Puerto Rico. He refers to sugar-cane mosaic.

Garanssini, L. A.

El "pasmo" del lino *Phlyctaena linicola* Speg. Ensayo de campo de resistencia varietal y estudio morfológico y fisiológico del parásito. ("Pasmo" of flax. *Phlyctaena linicola* Speg. Field experiment on varietal resistance and a morphological and physiological study of the parasite.) Rev. Fac. Agron. (La Plata) **20**(2) : 170–261, 1935.

Detailed account of experimental and field work of the disease. "Pasmo" of flax in Argentine caused by the fungus, *Septoria linicola* (Speg.) Nov. comb. (*Phlyctaena linicola* Speg.). A bibliography of 83 titles is appended.

Gardner, N[athaniel] L[yon]

New Myxophyceae from Porto Rico. Mem. New York Bot. Gard. **7**: 1–144, 1927.

Garman, Phillip

Some parasitic Porto Rican fungi. Mycologia **7**(6) : 333–340, 1915.

Gassner, G.

Die Getreideroste und ihr Auftreten im subtropischen östlichen Südamerika. Centralb. Bkt. Zweite Abt. **44**: 305–381, 1915.

Neue Feststellungen über Auftreten und Verbreitung der Getreiderostarten in Südamerika. (New facts concerning the occurrence and distribution of the cereal rusts species in South America.) Phytopath. Zeitschr. **4**(2) : 189–202, 1931.

Gives account of observation made by the author during a trip in South America in regard to the rusts found on cereals.

Gaumann, E.
Mykologische Notizen II (Mycological notes II) Ann. Mycol. **34** (1–2) : 61–68, 1936.
Mention is made in these notes on the occurrence of *Aecidium hippeastri* n. sp. on *Hippeastrum bicolor* leaves in Chile. Diagnose and description is given.

Giaccone, V.
Los principales enemigos del viñedo. (The principal enemies of the vineyard.) Defense Agric. (Uruguay) **1**: 67–70, 1920.
A popular report on the more important diseases including *Oidium, Plasmopara,* black-rot, chlorosis and a root rot.

Como curar el duraznero en primavera y princïpio de verano. (Treatment of the peach in Spring and early summer.) Defensa Agric. (Uruguay) **1**: 293–294, 1920.
Treatment for *Exoascus deformans* and *Aphis persicae.*

Gilber, Frank A[lbert]
Myxomycetes from British Guiana and Surinam. Mycologia **20**(1) : 27–28, 1928.

Girardi, José
Tumor bacteriano del duraznero. (Bacterial tumor of the peach.) Defensa Agric. (Uruguay) : **1**: 279–281, 1920.
A description of a gall which is said to be caused by *Bacterium persicae.*

La chlorosis de las plantas. (Chlorosis of plants.) Defensa Agric. (Uruguay) **1**: 300–302, 1920.

Gonoderma sessili Morrill. Argentina, Bol. Mins. Agric. de la Nación. **27**(1) : 236–239, 1922.
The author gives description of this fungus and his observations on its behaviour and treatment.

Girola, C[arlos] D.
Enfermedades del tomate en Argentina: Podredumbre apical (*Fusarium* sp.), Antracnosis (*Colletotrichum phomoides* Sacc.) *Peronospora* (*Phytophthora infestans* De Bary.) (Diseases of tomatoes in Argentine: Apical rot (*Fusarium* sp.), Anthracnose (*Colletotrichum phomoides* Sacc.) and *Peronospora* (*Phytophthora infestans* De Bary.) Bol. Min. Agric. Nac. Argentine **27**: 503–505, 1922.

Goldi, Emil August
Memoria sobre una enfermedad del cafeto en la Provincia de Río de Janeiro, Brasil. (Report on a disease of coffee in the Province of Río de Janeiro, Brazil.) Mexico, 118 p., 1894.

——— Relatorio sobre a molestias do cafeéiro do Río de Janeiro. (Report of coffee diseases in the Province of Río de Janeiro.) Arch. Mus. Nac., Río de Janeiro **8**: 9–121, 1897.

Gómez Menor, J.

Las plagas en la agricultura dominicana. (The pests in the dominican agriculture.) Bol. Sec. Publ. Difus. Agric. Sec. Estado Agric. & Com. Dominicana No. **12**, 41 p., 1934.

Account of fungus diseases on p. 29–36.

Hongos que atacan el rosal. (Fungi that attack the rose.) Rev. Agric. Santo Domingo **27**(78) : 2304–2303, 1936.

Popular notes are given on the rose diseases caused in the Dominican Republic by *Actinema* (*Diplocarpon*) *Rosae* and *Pestalozzia discosioides*. Control measures are suggested.

Hongos que ocasionan daños a las plantas "Flor de sol" (Fungi that damage sun-flower plants.) Rev. Agric. Santo Domingo **27**(80) : 2415, 1936.

Popular notes and control measures of three sunflowers diseases in the Dominican Republic.

Gonaux, C.B. et al.

Report of committee on Agricultural progress of the Louisiana Sugar Planters' Association for the year 1920. Louisiana Planter & Sugar Manuf. **66**: 185–189, 1921.

A report on the mosaic disease.

Goncalves Carneiro, Joao

A "mancha do olho pardo" da folha do Cafeeiro (The "brown spot" of coffee leaf.) Rev. Inst. Café. San Paulo (Brazil) **10**(104) : 1893–1895, 1935.

The brown spot of coffee (*Cercospora coffeicola*) is of little importance in Brazil. A description of the causal organism is given.

——— O tratamento des plantas citricas. (The treatment of citrus plants.) Rev. Citric. 7 p., 1935.

Popular direction for the treatment of the most common citrus diseases in Brazil.

——— A pathologia do cafeeiro. (The coffee pathology.) Rev. Inst. Café. Est. (S. Paulo) Brazil. **10**(105: 2131–2132, 1935.

Popular account about the importance of phytopathology in coffee culture of to-day.

Gonzales Fragoso, R[omualdo], & Ciferri, R[afael]

Hongos parásitos y saprófitos de la República Dominicana. (Parasitic and saprophytic fungi of the Dominican Republic.) Bol. R. Soc. Esp. Hist. Nat. **25**(8) : 356–368, 1925.

Hongos parásitos y saprófitos de la República Dominicana. (Parasitic and saprophytic fungi of the Dominican Republic.) Bol. R. Soc. Esp. Hist. Nat. **25**(9) : 443–456, (**10**) : 508–516, 1925.

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Hongos parásitos y saprófitos de la República Dominicana (9 Serie) (Parasitic and saprophytic fungi of the Dominican Republic (9th Serie). Bol. R. Soc. Exp. Hist. Nat. **27**(2) : 68–81, 1927.

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Hongos parásitos y saprófitos de la República Dominicana (**11**, 12, 13, 14, 15 Series) (Parasitic and saprophytic fungi of the Dominican Republic (Series 11–15) Estac. Agron. de Moca. (Santo Domingo) Ser. B. Botany. **11**, 79 p., 1928.

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Hongos parásitos y saprófitos de la República Dominicana. (Serie 16) (Parasitic and saprophytic fungi of the Dominican Republic (16 Serie) Bol. R. Soc. Esp. Hist. Nat. **28**(7) : 377–388, 1928.

González Ríos, Policarpo

El mal del plátano. Rev. Agr. Puerto Rico. **3**(5) : 51–55, 1919.

Popular account, very comprehensive.

Goodey, T.

On the nomenclature of the root-gall nematodes. J. Helm **VII** (4) : 223–230, 1932.

Gotoh, K.

On the black spot disease of the *Dioscorea alata* and *D. batatas*. (*Gloeosporium pestis* Massee.) Journ. Soc. Trop. Agric. **1**: 301–319, 1929.

Gough, Lewis Henry

List of fungoid parasites of sugar cane observed in Trinidad. Dept. Agric. Trinidad & Tobago Bull. **10**(69) : 177–181, 1911. 1911.

A list of the diseases with brief bibliographies of each one.

Gowdey, C[arlton]

Relationship of insects to mosaic disease of sugar cane. Jamaica Dept. Agric. Ann. Rpt. **1924**: 19–20. (Rev. Appl. Ent. ser. **A**. **12**: 442–445, 1924.

Graziana, A.

Deux champignos parasites des feuilles de coca. (Two parasitic fungi of coca leaves.) Bull. Soc. Mycol. France **7**: 152–153, 1891.

Gravier, Gabriel

Conferencia pronuncaida por el Dr. Carlos E. Chardón, Comisionado de Agricultura de Puerto Rico en la Estación Agronómica sobre la enfermedad del mosaico o matizado de la caña de azúcar. (Conference delivered by Dr. Carlos E. Chardón, Commissioner of Agriculture of Puerto Rico in the Agricultural Experiment Station on mosaic or mottling disease of sugar cane.) Rev. Agric. Com. & Trab. Cuba **7**(8): 29–32, 1925.

Guérin-Meneville, & Porrottet

Memoir sur un insects et un champignon qui ravagent les caféeirs aux Antilles. (Report on an insect and a fungus that attack the coffee tree in the Antilles.) Paris, Min. de la Marina, 32 p., 1842.

The authors describe and give biochemical data about a fungus which produces a disease on the coffee trees of the Antilles. The insect which they account for under the name *Elachiste coffeella* seems to be the first description of the well known coffee leaf miner.

Guilliermond, A.

A propos de l'origine des levures. Ann. Mycol. **5**: 49–69, 1907.

Guiscafré, Arrillaga, J[aime R.]

Gomosis de la toronja en la Hacienda Eugenia (Puerto Rico) (Grape-fruit gummosis in Hacienda Eugenia (Puerto Rico). Rev. Obras Publ. **8**(5): 124–125, 1931.

The brown rot fungus in Puerto Rico. Journ. Dept. Agric. Puerto Rico **16**(2): 193–202, 1932.

Phytophthora (Pythiacytis) citrophthora.

The nature of inhibition between certain fungi parasitic on Citrus. Phytopathology **25**(8): 763–775, 1935.

The fungi under study were *Diaporthe citri, Phytophthora parasitica* and *P. citrophthora* on *Citrus* in Puerto Rico.

Guzmán, D. J.

Una enfermedad del cafeto en San Salvador (A coffee tree disease in San Salvador.) Com. Par. Agric. (Mexico) Circ. **60**, 24 p., n. d.

Description of a coffee disease caused by the fungus *Stilbella flavida*. Account on its distribution and damages it causes. Bordeaux mixture is recommended as a control measure.

Harkness, Harvey Wilson

Fungi collected by T. S. Brandegee in Lower California in 1889. Proc. California Acad. Sci. II, **2**: 231–232, 1889.

Hagelstein, R[obert]

Mycetozoa from Porto Rico. Mycologia **19**(1): 35–37, 1927.

Hall, C[onatant] J[ohan] J[acob] van
The witch-broom disease in Surinam. Trop. Life **2**(6) : 83, **1906**.

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Les balais de sorciere du cacaoyer provoqués par *Colletotrichum luxificum* n. sp. (The witches-broom of cacao produced by *Collectotrichum luxificum* n. sp.) Recuil des Travaux Bot. Neederland, Vol. **4**, p. 77, 1907.

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(The witch-broom disease in Suriname, its cause and treatment.) Suriname Dept. van Landb. Bull. **16**, 1909. (Agric. Soc. Trinidad & Tobago Soc. Paper No. **398**, 1909.)

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The mosaic disease of sugar cane. Jamaica Dept. Agric. Microb. Circ. **2**, 14 p., 1923.

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Results of work on *Fusarium cubense*. Also mentions mosaic of sugar cane, *Colletotrichum falcatum*, *Marasmius sacchari*, coconut bud

rot, *Cercospora nicotianae, Cladosporium fulvum, Phomopsis* sp. on mango, *Guignardia bidwelli* and *Plasmopara viticola* of grape, *Colletotrichum agaves* on sisal, *Fusarium* sp., *Phytophthora* sp., *Thielaviopsis paradoxa* and bacteria of pineapple. Also *Aschersonia goldiana* on *Aleurocanthus woglumi.*

The Panama disease of bananas. Jamaica Dept. of Agric. Microbiol. Circ. I, 28 p., 1923.

Tomato diseases and their control. Jamaica Dept. Agric. Microb. Circ. 3, 12 p., 1923.

Describes damping off in seed beds due to *Rhizoctonia, Fusarium* and *Pythium.* Also *Cladosporium fulvum, Septoria lycopersici, Fusarium lycopersici, Bacterium solanacearum, Phytophthora infestans, Fusarium solani, Macrosporium solani* and *Colletotrichum phomoides.*

Report of Government Microbiologist. Ann. Rept. Dept. Agric. Jamaica for the year ending 31st. December **1923**: 23–25, 1924.

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Panama disease of the Gros Michel banana. Proc. Agric. Soc. Trinidad & Tobago **26**(12): 557–578, 1926.
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A summary of our knowledge of this disease.

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The mosaic disease of sugar cane and its control in Jamaica. Jamaica Dept. Agric. Microb. Circ. **6**, 39 p., 1926. (Int. Sugar Journ. **29**(341): 240–242, 1927. Rev. Appl. Ent. ser. **A**. **15**: 96, 1927. Rev. Appl. Mycol. **6**: 185, 1927.)
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On the genetics of crinkled dwarf rogues in sea island cotton Part II. West Indian Bull. **16**(4): 353–355, 1918.

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A discussion of the efforts to control this disease which is caused by *Gloeosporium limetticolum.*

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Some fungi of the cacao tree. West Indian Bull. **1**(4): 422–427, 1900.

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Una enfermedad del café en Perú. (A coffee disease in Perú.) Bol. Min. Fomento (Perú) **4**(9) : 30–39, 1906.

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Nachträge zur Plizflora Sudamerika II. Hedwigia **36**: 190–192, 193–246, 1897.

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Einige neue pilze aus Costarica und Paraguay. Hedwigia **43**: 147–149, 1904.

Fungi amazonici a Cl. Ernesto Ule collecti. Hedwigia **43**: 154–186, 242–273, 351–352, 353–400, 1904; **44**: 57–71, 1906.

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Notes on Mexican lichens. Bryologist **23**: 3–4, 1920.

Herrera, A. L.
Las plagas de la agricultura. (The agricultural pests.) México Min. de Fomento, Parts **3–7**: 179–434, 1903.
Popular account of crop pests in Mexico.

Algunas enfermedades del cafeto. (Some coffee tree diseases.) Com. Par. Agric. (México) Circ. **1**, 8 p., n. d.
Brief discussion on the diseases caused by *Stilbum flavidum* and *Sphaerella coffeicola*. Bordeaux mixture is recommended as a control measure.

Resultados prácticos al combatir las plagas agrícolas. (Practical results in combating agricultural pests.), Com. Par. Agric. (México) Circ. **11**, 49 p., n. d.
Popular notes on practical results obtained with fungicide used on agricultural crops in Mexico.

La enfermedad del cafeto en Oaxaca. (The coffee tree disease in Oaxaca.) Bol. Com. Par. Agric. (México) **2**(5): 207–276, 1904.
Summary of reports on the disease caused by the fungus *Stilbella flavida*. Other organisms are considered in this report. Bordeaux mixture is given as a remedy for most leaf troubles of coffee of fungus origin.

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Progress report on citrus scab. Puerto Rico Agric. Expt. Sta. Report. **1917**: 30–31, 1918.
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Mycological notes. Trop. Agric. (Trinidad) **5**(4): 93, 1928.
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A visit to the West Indies. Kew Bull. Misc. Inf. p. 166–189, 1912.

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Transportation of citrus fruits from Puerto Rico. U.S.D.A. Bull. **1290**, 19 p., 1924.
A paper on refrigeration. The one fungus mentioned is *Diplodia natalensis*.

Hirschhorn, Elisa, & Hirschhorn, J.

Los carbones del maíz en la Argentina. Caracteres sistemáticos, genéticos y parasitorios. Observaciones preliminares. (Maize smuts in the Argentine. Systematic, genetic and parasitic characters. Preliminary observations.) Rev. Fac. Agron. La Plata **20**(2) : 108–139, 1935.

Corn smuts in the Argentine Republic has hitherto attributed extensity to *Ustilago Zeae* and *U. abortifera* described by Spegazzini in 1881, but the authors made extensive studies on the systematic position, biology and pathogenicity of diseased material from all over the country as well as from Venezuela and Paraguay. The results of their studies are given in detail.

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Dos royas de la cebada, nuevas para la Argentina. (Two barley rusts new to the Argentine.) Rev. Fac. Agron. Univ. Nac. La Plata **19**(3) : 390–397, 1933.

This is a continuation of work published in 1930 reporting on that date the appearance of these two rusts on barley in the Argentine Republic. (*Puccinia anomala* and *P. glumarum.*) After describing the life-history and symptoms of the former it is stated that judging by the character of the infection on different species (*Hordeum spontaneum* and *H. deficiens.*) and several other varieties the biotype of *P. anomala* occurring in Argentine is distinct from those found in Australia and United States. *P. glumarum* has been found to occur in a much more virulent form on *H. spontaneum* and its var. *nigrum*, H. *tetrastichum*, and *H. hexastichum* than on *H. distichum*. In 1931 *H. pusillum* Nutt. var. *enclaston* Steud (*H. enclaston* Steud.) was attacked by yellow rust.

Dos royas de la cebada nuevas para el país. (Two barley rusts new to the country.) Physis, Rev. Soc. Argentina Cienc. Nat. **11**(38) : 166–167, 1933.

Records the occurrence of *Puccinia anomala* on *Hordeum distichun* and *P. glumarum* on *H. tetrastichun*, *H. hexastichun*, *H. spontaneum*, *H. spontaneum* var. *nigrum*.

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Eumycetes et Myxomycetes. In Wettstein, R. and Schiffner. V. Ergebaisee der botanischen expedition der Akademie der wissenschaften nach Südbrasilien 1901. v. 2 Deutschr. Matu-Natur. Kl. Akad. Wiss. Wnero **83**: 1–45, 1927.

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(In Kunth, C. S.) Synopsis plantarum quas in plagam aequinoctialem Orbis Novi collegerunt Al. de Humboldt et Am. Bonpland p. 7–15, 1822.

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Notes on the soft rot of cotton bolls in the West Indies caused by *Phytophthora*. Ann. Bot. **39**(154) : 267–280, 1925.
Report of three strains of *Phytophthora* on cotton bolls. One from Montserrat resembled *P. parasitica;* one from St. Vincent indistinguishable from *P. palmivora* and one from Trinidad resembling *P. parasitica.*

Horne, Mary Tracy [Earle]
The coconut industry in Cuba. Cuba Rev. **5**(11) : 18–20, 1907.
Popular.

Horne, W[illiam] T[itus]
The bud rot and some other coconut troubles in Cuba. (English & Spanish Ed.) Est. Central Agron. Cuba Bull. **15**, 43 p., 1908.
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Phomopsis in grapefruit from the Isle of Pines, W. I., with notes on *Diplodia natalenses.* Phytopathology **12**(9) : 414–418, 1922.

Hotson, J. W., & Hartge, Lena
A disease of tomato caused by *Phytophthora mexicana.* n. sp. Phytopathology **13**(12) : 520–530, 1923.
This organism was isolated from tomatoes shipped from Mexico to Washington.

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On *Trichosphaeria sacchari* Massee. Ann. Bot. **14**: 617–631, 1900.

Diplodia cacaoicola a parasitic fungus on sugar cane and cacao in the West Indies. Ann. Bot. **15**(60) : 683–701, 1901.

The fungus diseases of cacao in the West Indies. West Indian Bull. **2**(3) : 190–211, 289, 1901.
This paper contains a discussion of the brown rot disease of the pod (*Diplodia cacaoicola* P. Henn.), the Trinidad cacao pod disease (*Phytophthora omnivora* de Bary), *Nectria bainii* Massee; a canker disease (*Nectria ditissima* Tul.) of the stem which also attacks *Erythrina umbrosa,* the witch-broom disease of Surinam (*Exoascus theobromae* Ritz. Bos.) and root disease.

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This paper gives the results of efforts to control *Thielaviopsis* by treatments with Bordeaux mixture, tar, lime, water, etc.

Suggestions for the removal of epiphytes from cacao and lime trees. West Indian Bull. **3**(2): 189–197, 1902.
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The rind disease of sugar cane in the West Indies. Intern. Sugar Journ. **5**(53): 215–225, 1903.
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The *Usneas* of the World, 1752–1914, with citations types localities, original descriptions and keys. Part II, South America. Bryologist **18**: 38–43, 52–63, 1915.

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Antracnosis de la vid. (Vine anthracnose.) Buenos Aires 28 p., 1899.

Enfermedad radicular de la vid causada por la *Heterodera radicicola* o *Anguilula radicicola* de Greef (Anguilulosis) (Root disease of the vine caused by *Heterodera radicicola* or *Anguilula radicicola* Greef.) Bol. Min. Agric. Buenos Aires **5**(1): 29–56, 1906.

Enfermedad radicular del tomate. (Root disease of the tomato.) Bol. Agric. & Ganadería, Rep. Argentina, **2**(42): 1040–1059, 1902.

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Stripe rust, *Puccinia glumarum*, on wheat in Argentine. Phytopathology **20**(12): 981–986, 1930.
Description of the symptoms of the disease and its behavior.

Humboldt, Alexandri de, Bonpland, Aamati, & Kunth, Carol Segismund.
Nova genera et Species Plantarum quas in peregrinaciones ad plagam aequinoctialem Orbis Novi collegerunt, descripserunt, partim adumbraverunt Amat. Bonpland et Alex. Humboldt, exchedis autographis Amati Bonpland in ordinem digessit Carol Segismund Kunth accedunt tabulae acri incisae, et Alexandri de Humboldt natationes ad geographiam plantarum spectantes. Lutecia Parisorum **VII**, 1895.

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Miscellaneous collections of North American rusts. Mycologia **19**(5): 286–288, 1927.

Records *Uromyces Fabae* (Pers.) De Bary on *Vicia Faba* L., *Coleosporium Solidaginis* (Schw.) Thüm on *Solidago sempervirens* L., *Gymnosporagium bermudianum* (Farl.) Earle on *Juniperum bermudiana* L., *Puccinia Hieracii* (Schum.) Mart. on *Cichorium Intybus* L., *P. Lantanae* Earl. on *Lantana involucrata* L., and *U. Medicagines* Pass. on *Medicago lupulina* L. all from Bermuda.

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Der brasilianische Korceebau und seine Schadlinge. Mittil. uber Brasilien, Berlin 661–670, 1925.

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Notes on gumming disease of sugar cane. Leeward Islands Dept. Agric. 12 p., 1930.

The author gives a brief discussion of the symptoms, effects of the disease, the causal organism, dissemination and varietal susceptibility.

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Nociones sobre enfermedades del cafeto. (Notions on coffee tree diseases.) Rev. Cafetera de Colombia **4**(36–37): 1351–1353, 1932.

Brief notes on coffee diseases specially those of fungus origin. Special attention is given to those caused by *Hemileia vastatrix* and *Corticium Koleroga.*

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Observaciones sobre el carate en el Distrito Perijá del Estado Zulia. (Observations on "carate" in the District of Perijá, State of Zulia.) Gaceta Muskus, Caracas **3**(34): 16–18, 1932.

Carate: A disease of the skin—dark spots.

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The rusts of South America based on Holway Collection V. Mycologia **23**(6) : 463–503, 1931.

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Work connected with insect and fungus pests and their control. St. Vincent Dept. of Agric. Ann. Rpt. **1928**: 8–14, 1929.

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Les balais de sorciere du cacaoyer et les moyens de les eviter. (Witches' broom of cacao and the means of avoiding it.) Agron. Colon (Ecuador) **18**(137) : 129–133, 1929.

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Myxomyceten aus Amazonas gesammelt E. Ule. Hedwigia **43**: 300–305, 1904.

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Phoma Destructiva the cause of a fruit rot of the tomato. Journ. Agric. Res. **4**(1) : 1–20, 1915.

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Pineapple disease, (*Thielaviopsis ethaceticus*) on sugar cane at Tucumán, Argentina. Phytopathology **22**(7) : 667–668, 1932.

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El tizón tardío y la pudrición de la papa. (Late blight and potato rot.) Cuba Est. Expt. Agron. Circ. **48**, 6 p., 1915.

Jenkins, Anna E[liza]

A scab disease of lima bean in Cuba and Puerto Rico. U.S.D.A. Plant Disease Reporter. **14**(11): 96–97, 1930.

This disease of *Phaseolus lunatus* is caused by *Elsinoe canavaliae.* The author published a very complete discussion of this fungus and the disease in Journ. Agric. Res. 42(1): 13–23, 1931.

Lima bean scab caused by *Elsinoe.* Journ. Agric. Res. **42**(1): 13–23, 1931.

Further studies of lima-bean scab. Phytopathology **23**(8): 662–666, 1933.

This disease is due to *Elsinoe canavaliae.* The range has been extended to Costa Rica, Nicaragua, Guatemala, El Salvador, Dominican Republic and possibly to Jamaica.

A *Sphaceloma* attacking naval orange from Brazil. Phytopathology **23**(6): 538–545, 1933.

A species of *Sphaceloma* on avocado. Phytopathology **24**(1): 84–85, 1934.

New species.—*Sphaceloma perseae.*

Jensen, J[ames] H.

Notes on the present Sugar-cane diseases situation in Puerto Rico. Agric. Notes, Puerto Rico Agric. Expt. Sta. (Mayagüez) **69**, 8 p., 1936.

Brief popular notes on the occurrence of the most common disease of sugar cane in Puerto Rico.

Notas sobre la presente situación de las enfermedades de la caña de azúcar en Puerto Rico. Rev. Agric. Puerto Rico. **18**(1): 89–94. 1936.

Popular.

Chlorosis of Citrus in Puerto Rico Phytopathology, **27**(6): 731. 1937.

Treatment with zinc sulphate.

Jiménez Núñez, E.

El cultivo de la caña de azúcar. (Sugar-Cane Cultivation.) Centro Nal. de Agric. (Argentina) Bull. **6**: 3–24, 1930.

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Sur une maladie du cafeier observée au Brasil. Compt. Rend. Hebdomadáires des Séances de l' Académie d' Agri., France **87**: 941–943, 1878.

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"El mosaico" enfermedad del tabaco. Rev. Agric. Puerto Rico. **25**(10) : 150, 176, 1930.
Popular discussion and description.

Johann, Helen
Diplodia macrospora on corn in Brazil. U.S.D.A., Plant Disease Rep. **19**(1) : 9–10, 1935.
A record of this disease on corn from Brazil where it is considered new. This fungus was described by Earle and has been reported from Alabama, North Carolina, South Carolina, Florida and Louisiana.

Johansson, N.
A contribution to the knowledge of the etiology of fruitlet black rot disease of pineapple. Svensk. Bot. Tidskr., **28**(3) : 384–404, 1934.
An account of this disease in Guatemala. The author accepts the work of Barker in Haiti and Serrano in the Philippine that the disease is caused by *Bacillus ananas.*

Johnston, John R[obert]
The bud-rot of the coconut palm. U. S. Bur. Plant Indus. Circ. **36**, 5 p., 1909.
A brief history of the disease without statement as to cause.

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The serious coconut palm diseases in Trinidad. Dept. Agric. Trinidad, Bull. **9**(64) : 25–29, 1910.
A popular discussion.

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The history and cause of coconut but-rot. U. S. Plant Indus. Bull. **228**, 175 p., 1912.
These studies were made on material from Cuba and the author attributed the disease to *Bacillus coli* (Escherich) Migula. Later studies of what appear to be the same disease in Puerto Rico indicated that it is due to *Phytophthora palmivora.*

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The present status of the coconut bud rot disease. 1910. (Published in Cuba.)
A brief history of the disease and its geographical distribution. No statement as to cause.

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Is *Bacillus coli* ever a plant parasite. Phytopathology **1** : 97–99, 1911.

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First report of the pathologist. Puerto Rico Agric. Expt. Sta. Sugar Prod. Ass'n. Bull. **1** : 35–48, 1911.

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Report of the pathologist. Puerto Rico Sugar Prod. Assoc. Agric. Expt. Sta. Second Ann. Rpt. **1911–12**(Bulletin **2**) : 23–28, 1912.

Cultivation of the coconut in Puerto Rico. Puerto Rico Hort. Soc. First Rpt. **1912**: 47–55, 1912.

The relation of cane cultivation to the control of fungous diseases. Puerto Rico Agric. Expt. Sta. Sugar Prod. Assoc. Circ. **3**, 13 p., 1913.

Selection and treatment of cane seed. Puerto Rico. Agric. Expt. Sta. Sugar Prod. Assoc. Bull. **6**, 29 p., 1913.

Notes on the fungous diseases of sugar cane in Puerto Rico. Phytopathology (Abstract) **3**: 75, 1913.

Third report of the pathologist. Puerto Rico Sugar Prod. Assoc. Agric. Expt. Sta. Bull. **5**: 22–24, 1913.

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La enfermedad del plátano en Cuba. (The plantain disease in Cuba.) Cuba Estac. Expt. Agron. Circ. **47**, 13 p., 1915.

Causa de la enfermedad llamada pudrición del cogollo del cocotero. (Cause of the so called coconut palm bud rot.) Cuba Estac. Expt. Agron. Bull. **27**, 106 p., 1915.

Entomogenous fungi of Puerto Rico. Ins. Expt. Sta. Puerto Rico. Bull. **10**, 33 p., 1915.

Phytopathological work in the tropics. Phytopathology **6**: 383, 1916.

The banana diseases and its control. Bull. Comm. San. Veg. Cuba, **1**: 80–81, 1917.

Popular.

History and cause of the rind disease of sugar cane. Journ. Comm. Agric. Puerto Rico **1**(1): 17–45, 1917.

Notas sobre micología y patología vegetal en Cuba. (Notes on mycology and plant pathology in Cuba.) Mem. Soc. Cubana Hist. Nat. **2**: 225–228, 1917.

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Fungi and diseases of sugar cane in Puerto Rico. Journ. Dept. Agric. Puerto Rico **1**(4): 228–233, 1917.

Brief notes: Early account of the occurrence of mosaic disease of sugar cane (called mottling) in Puerto Rico.

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Sugar-cane fungi and diseases of Puerto Rico. Journ. Dept. Agric. Puerto Rico **1**(4) : 177–264, 1917.

El plátano y sus enfermedades. (Banana and its disease.) Rev. Agric. Com. & Trab. Cuba, **1** : 419–421, 1918.

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A *Phyllachora* of the Royal Palm. Mycologia **10**(1) : 43–45, 1918.

Enfermedades y plagas del cacao en el Ecuador y métodos modernos apropiados al cultivo del cacao. (Cacao diseases in Equador and methods of cacao cultivation.) Phytopathology **8**(10) : 550, 1918.
Review of paper of same title by J. B. Rorer.

Algunos hongos entomógenos de Cuba. (Some entomogenous fungi from Cuba.) Mem. Soc. Cubana Hist. Nat. "Felipe Poey" **3** : 61–82, 1918.

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Enfermedades del naranjo y otras frutas cítricas. (Diseases of the orange tree and other citrus.) Cuba Est. Expt. Agron. Bull. **38**, 54 p., 1918.

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Diseases of sugar cane in tropical and subtropical America, especially the West Indies. West Indies Bull. **16**(4) : 298–300, 1918.
Brief notes on sereh and mosaic disease of sugar cane, the first in Java and the second in Puerto Rico. Description of both diseases.

The new cane disease in Cuba. The Louisiana Planter & Sugar Manuf. **63**(6) : 43, 1919.
The author declares that the disease is present in at least three provinces. Quarantine measures are recommended. The author discusses the history of the disease in other countries.

La enfermedad del "mosaico" de la caña de azúcar. (The disease, "mosaic" of sugar cane.) Sección de Sanidad Vegetal, Cuba Circ. **6**, 11 p., 1919.
The author gives a popular discussion and recommendations.

The mosaic disease of sugar cane in 1923. (A discussion of the problem to data.) United Fruit Co., Agric. Res. Dept. Pamphlet, 35 p., 1923. (Louisiana Planter **73**(1) : 10–11, (2) : 30–32, (3) : 49–52, 1924. The Int. Sugar Journ. **26** : 469–473,

1924. A Review by C. A. Barber in Rev. Agric. Puerto Rico **13**: 265–272, 1924.)

A popular but very comprehensive discussion of this disease.

Control of sugar cane mosaic. Louisiana Planter **74**(10): 190–191, 1925.

The disease spreads slowly in Cuba. Control by inspection and roguing is recommended.

The Panama disease or banana wilt. The United Fruit Co., Res. Dept. Circ. **2**, 1928.

A description with suggestions for control.

Enfermedades y plagas de la piña en América Tropical. Rev. Agric. Puerto Rico **26**: 4–11, 1931. (Bol. Union Panamerica **65**(½): 88–103, 1931.)

A popular description of diseases and insects.

The fruit spot of the banana. United Fruit Res. Dept. Bull. **43**, 1932.

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The banana fruit spot and its control. United Fruit Co., Res. Dept. Bull. **41**, 1932.

Jonge, Mevr. A. E.

Department van den Landvouw in Surinam, Bull. **24**, April, 1910.

Kaden, O. F.

Observations concerning the healthiness of coffee in Costa Rica Trop. Agric. (Trinidad) **9**(11): 350–351, 1932.

The author reports about the healthy conditions of the coffee groves he found in Costa Rica. He states that he only noticed *Omphalia flavida, Cercospora coffeicola* and a species of *Rosellinia,* but none of these organisms are of importance. He also observed a non parasitic disease of minor importance. He concludes by giving recommendations to prevent them.

Karling, J. S.

Fungi of British Honduras I. Ann. Mycol. **34**(1–2): 1–10, 1936.

A full description is given of the fungus *Hypocrella (Aschersonia) turbinata* (Berk.) Petch. observed by the author parasitizing the wax scale (*Ceroplastes floridensis*) on lime leaves, petioles and fruits in British Honduras.

Kellerman, William Ashbrook

Mycological expedition to Guatemala. Contribution to Guatemalan Mycology I. Journ. Mycol. **12**: 137–145, 1906.

Fungi selecti guatemalensis. Exsiccati decade I–II. Journ. Mycol. **12**: 238–241, 1906; **13**: 99–102, 1907.

Dr. Rehm's first report on Guatemalan *Ascomycetae*. Contribution to Guatemalan Mycology V. Journ. Mycol. **14**: 3–7, 1908.

Kern, Frank D[unn]
The rusts of Guatemala I. Jour. Mycol. **13**: 18–26, 1907.

The rusts of Guatemala II. Mycologia **3**(6): 288–290, 1911.

North American rusts on *Cyperus* and *Eleocharis*. Mycologia **11** (3): 134–147, 1919.

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Observaciones en las enfermedades del cafeto y de los árboles de sombra. (Observations on coffee tree diseases and of the shade trees.) Rev. Agric. Puerto Rico **13**(1): 7–11, 1924.

Brief popular notes giving the authors' observations on the most prevalent coffee and shade tree (*Inga Inga*) diseases. They suggest the foundation of a coffee experiment station in the center of Puerto Rico (in the coffee region) to observe and study these diseases in the coffee groves.

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Some new or interesting Porto Rican rusts. Mycologia **18**(1): 39–47, 1926.

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Notes on some rusts of Colombia. Mycologia **19**(5): 268–276, 1927.

Fungi of Santo Domingo II. Uredinales. Mycologia **20**(2): 50–82, 1928.

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Fungi of Santo Domingo III. Uredinales. Mycologia **22**(3): 111–117, 1930.

Supplement to Uredinales. Sci. Survey Puerto Rico & The Virgin Islands **8**(2): 226–231, 1932.

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The rust-flora of the Dominican Republic. Ann. Mycol. **31**(1–2): 1–40, 1933.

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Annotated index of the rusts of Colombia. Mycologia **25**(6): 448–503, 1933.

The microcyclic species of *Puccinia* on *Solanum*. Mycologia, **25**(6): 435–441, 1933.

A study of *Puccinia pittieriana* on potato.

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Notes on some fungi from Colombia. Mycologia **27**(6): 615–617, 1935.

This is an annotated list of nine species of fungi, mostly rusts collected by the authors in 1932, including *Cerotelium desmium* on cotton (*Gossypium peruvianum*.)

Kick Jr., Jean

Notice sur quelques champignons du Mexique. (Note on some fungi from México.) Bruxelles, M. Hayez 1841. From Bull. Acad. Roy. Belg. **VIII**, No. 8, 1841.

Klotzsch, J.

Schwanecke.—Collection of fungi. Linnaea **25**: 364–366, 1852.

Knoche, W., Cruz-Coke, E., & Pacotet, M.

Der "Palo podrido" auf Chiloe. Ein Beitrag zur Kenntnis natürlichen Umwandlung des Holzes durch Pilze in ein Futtermittel. (The "palo podrido" on Chiloe.) Centralb. Bakt. 2 Abt. **79**(15–22): 427–431, 1929.

Krug, H. P.

A podridao interna dos capulhos do algodeiro no estado de Sao Paulo. (Internal boll rot of cotton in the State of San Paulo.) Bol. Tech. Inst. Agron. Campinas **23**(1): 1–19, 1936.

A brief summarizing account is given of the history, host, range, distribution, economic importance, symptoms, etiology and insect vectors of internal boll rot of cotton. The organisms associated with this disorder are reported to be *Nematospora coryli*, *N. gossypii*, yeasts and *Penicillium* sp. Bacteria appear to be the most active agent in the causation of the disorder. By means of insects vectors it is conveyed to various wild and cultivated *Malvaceae*, such as *Sida* and *Hibiscus*. *N. coryli* was isolated from cowpeas.

Kuijper, J[an] *

Department van den Landvouw in Suriname, Bull. **28**: 3–10, 1912.

(Phytopathological observations) Suriname, Dept. van den Landb. Verslag (Annual Report) **1911**: 16–22, 1912.

Brief notes on crop plants reported during the year in Dutch Guiana; it includes a list of fungi determined and studied during the year.

Een fusiclacium-ziekte opheves. De zilver-drand Ziekte der Koffie in Surinam. De gevolgen van Kenkenzout-hounded water voor begieting en bespuiting. Dept. van den Landbouw. Bul. **2**: 31, 1912. (Rec. Trav. Bot. Néerlard, **9**(4): 436–451, 1912.)

* Also written *Kuyper*.

(Cacao canker) Dept. Landb. Suriname. Bull. **31**: 29–33, 1913.

Overzich van Koffieziekten in Suriname. (Considerations on coffee diseases in Surinam.) Dept. van den Landbouw, Suriname. Bull. A 311–316, 1913.

Brief description of the coffee diseases occurring in Surinam since 1900.

(Fungi causing diseases in Suriname.) Trav. Bot. Néerland **11**(1) : 44–53, 1914.

Kurtz, F.
Essai d' un Bibliographie botanique de l' Argentine. (Essay of a botanical bibliography from Argentine.) Bol. Acad. Nac. Ciencias de Córdoba **16**: 117–208, 1900; **19**: 221–376, 1913.

L. (E.)
La production du cacao a l' Equateur. (The production of cacao in Ecuador.) Agron. Colon **16**(113) : 173–174, 1927.

Refers to *Marasmius perniciosus.*

Labroy, O.
Les maladies du bananier a Suriname et dans le Central Amerique. (The banana diseases in Surinam and Central America.) Journ. Agric. Trop. **10**: 328–332, 1910.

A review of the work in America.

Legerheim, G. de
La enfermedad de los pepinos. (The diseases of cucumber.) Rev. Ecuatoriana **2**: 1–6, 1890.

Observations on new species of fungi from North and South America.. Journ. Mycol. **7**(1) : 44–50, 1891.

Om förekomstem af europeiska Uredineer pa Quitós höglätt. Bot. Notiser, Lund, p. 63–66, 1891.

Pucciniosira, Chrysospora, Alvoolaria und Trichospora, vier neuw Uredineen-Gattungen mit tremelloider Entwickelung. (Vorlaufige Mittheilung.) Ber. d. Deutsch Bot. Gesell **9**(10) : 344–348, 1892.

Larter, L. N. H.
The highgate banana and Panama disease. Journ. Jamaica Agric. Soc. **40**(9) : 528–529, 1936.

Lathrop, E. C.
The generation of aldehydes by *Fusarium cubense.* Phytopathology **7**(1) : 14–16, 1917.

Laubert, R.
Die *Gloeosporium*-Faüle der in Deutschland gehandeten Bananenen. (The *Gloeosporium* rot of banana on the German markets.) Mitt. Gesell. Vorratschutz, **2**(2): 19–21, 1926,

A brief discussion of *Gloeosporium musarum* on bananas from Jamaica. The author describes the organism and proposes the name *G. musarum* var. *importatum*. It has been suggested that this is the same as *G. fructigenum f. americana.*

Leach, R., & Wright, J.
Collar and stem canker of pigeon pea, (*Cajanus indicus*) caused by a species of *Physalospora*. Mem. Imp. Coll. Trop. Agric. Trinidad (Mycol. Ser.) **1**(4): 12, 1930.

Leechman, Alleyne
The radical cure of infectious plant diseases. Journ. Bd. Agric. British Guiana **2**(3): 104–106, 1909.

Leenhoff, J. W. van
A disease of coffee. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1906**: 32, 1907.

Brief report on coffee leaf spot disease caused by *Stilbella flavida*, Bordeaux mixture is recommended as a control measure.

Lendner, A.
Un champiagnon parasite sur une *Lauracée* du genere *Ocotea*. (A parasitic fungus on a *Lauraceae* of the genus *Ocotea*.) Bull. Soc. Bot. Genéve II, **12**: 122–128, 1921.

Leonard, E. R.
The storage of Trinidad Citrus fruits. Mem. Low. Temp. Res. Sta. Trinidad **2**: 47, 1936.

A report of cold storage studies on grapefruit and oranges. The fungi were *Botryodiplodia theobromae, Penicillium digitatum* and *Colletotrichum gloeosporioides*. These fungi and the following additional ones were found in the packing sheds,—*Dothiorella (Botryosphaeria) ribis, Oospora* sp., *Fusarium lateritium* var. *fructigemum, Eidamia* sp. and *Aspergillus niger.*

Lévéille, J. R.
Fungi nova-granatense. Triana & Planchou. Prodomus florae novo-granatensis. Ann. Sci. Nat. 4 S. Bot. **20**: 282–300, 1863.

Champignons exotiques (Exotic fungi) Ann. Sci. Nat. III. **2**: 167–221, 1884, **3**: 38–70, 1885.

Lewton-Brain, L.

Fungoid diseases of cotton. West Indian Bull. **4**: 425–467, 1903.

Popular. Refers to root gall (*Heterodera radicicola*), root knot (*Ozonium*), wilting or frenching, sore shin or damping off (*P. de Baryanum*), mosaic or yellow blight, red leaf blight, angular leaf spot, leaf blight (*Sphaerella gossypina*) areolate mildew (*Ramularia areola*), cotton rust (*Uredo gossypii*), shedding of bolls, cotton boll rot (*Bacillus gossypinus*), and anthracnose (*Colletotrichum gossypii.*)

Disease-resisting varieties of plants. West Indian Bull. **4**(1): 48–57, 1903.

Discussion of the subject giving a review of the work done so far.

Lectures on the diseases of the sugar cane. Barbados, Pamphlet No. **29**, 1904.

West Indian Anthracnose of cotton. West Indian Bull. **5**(2): 178–194, 1904.

A report on this disease including symptoms, a description of the fungus (*Colletotrichum gossypii*) and the results of experiments.

Review of the principal fungoid diseases of the sugar cane. West Indian Bull. **6**(1): 33–37, 1905.

A discussion of the rind disease (*Trichosphaeria sacchari*), root disease (*Marasmius sacchari*). Says that *Marasmius semiustus* attacks banana in the West Indies.

Fungous diseases of cacao. West Indian Bull. **6**(1): 85–94, 1905.

Fungoid diseases of cotton. West Indian Bull. **6**(2): 117–123, 1905.

This paper contains brief discussions of rust (*Uredo gossypii*), leaf spot (*Cercospora gossypina*), mildew, anthracnose (*Colletotrichum gossypii*), black boll, dropping of bolls.

Levy, H. I.

The banana disease and other enemies of the plant in Costa Rica. Journ. Jamaica Agric. Soc. **14**: 241–247, 1910.

Not very definite.

Lindau, G.

Beiträge zur Pilze flora Süd-Amerikas. Einleitung. Hedwigia **35**: 202–207, 1896.

Sphaeriales. In Engler und Prent. Die Naturaliche Pflanzenfamilien, Teil I .Abt. **1**: 421, 1897.

Fungi Lichens: In Perkins J., Beiträge sur Flora von Bolivia. Bot. Jahrb. 49: 173, 1912.

Lindquist, Juan C.
Algunos hongos nuevos parásitos de las plantas cultivadas de la República Argentina. (Some new parasitic fungi of the cultivated plants in the Argentine Republic.) Rev. Agron. Univ. Nac. La Plata (Argentina) **19**: 197–210, 1930.

Sobre la presencia de la *Phytopthora capsici* en la República Argentina. (On the occurrence of *Phytophthora capsici* in the Argentine Republic.) Physis **11**: 170–174, 1932.

La "quemadura" de las hojas de narcisos y junquillos. (*Stagonospora Curtisii*) (Leaf scoarch of narcissus and jonquils. *Stagonospora Curtissi.*) Rev. Argent. Agron. **2**(7): 237–244, 1935.
The author gives the description of the disease and control measures of the fungus *Stagonospora Curtissi* the causative agent on *Narcissus pseudonarcissus* and *N. tazetta.*

Lister, A.
Mycetozoa of Antigua and Dominica. Journ. Bot. **36**: 112–122, 1898.

Mycetozoa of Antigua. Journ. Bot. **36**: 378–379, 1898.

Lizer, Carlos
Quelques notes pour servir de complement au recueil de Mr. L. Hauman-Merk sur. "Les parasites vegétaux des plantes, cultivées en Argentine et dans les régiones limitrophes." (Some notes to serve as a complement to the work of Mr. L. Hauman-Merk on "The vegetable parasites, of cultivated plants in Argentine and adjoining regions.") Ann. Soc. Cien. Argentina **78**: 5–17, 1914.

Lloyd, C[urtis] G[ates]
Lycoperdum albidum. Mycological Notes **42**: 582, 1916.

Polystictus ninuosus. Mycological Notes **45**: 626, 1917.

Notes on *Xylarias.* Mycological Notes **48**: 675–677, 1917.

Xylaria fumbriata. Mycological Notes **51**: 726, 1917.

Loew, [Carl Benedict] Oscar
Diseases of tobacco. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1907**: 16–18, 1908.

The fermentation of the cacao and coffee. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1907**: 41–55, 1908.

López Domínguez, F[rancisco] A[ntonio]

Has yellow stripe or mottling disease any effect on the sugar content of cane juice? Journ. Dept. Agric. Puerto Rico **3** (4): 47–64, 1919.

Analytical studies which indicate that the disease does not affect materially the sugar content of the juices unless the stalk is drying.

Chemical variations in yellow striped cane. Ins. Expt. Sta. Puerto Rico Ann. Rpt. **1920**: 77–78, 1920.

La caña Uba y su rendimiento de azúcar en Puerto Rico. (Yield of the Uba Cane in Puerto Rico.) Ins. Expt. Sta. Puerto Rico. (Eng. & Spanish.) Bull. **28**, 1923.

The author points out the importance of this variety to save the sugar-cane industry from the mosaic epidemic.

El matizado o mosaico de la caña: Sus síntomas sobresalientes. (Sugar cane mosaic: Outstanding symptoms.) La Vida Agrícola, Lima, Perú, **4**(46): 803–806, 1927.

Informe Anual del Director Estación Experimental Insular. Agric. Puerto Rico **1925–26**: 1–62, 1927.

Contains records of a few diseases.

Mosaico de la caña de azúcar. Inform. & Mem. Soc. Ingen. Perú **10**(30): 445–455; **11**: 466–478, 1928.

Popular.

El Matizado de la caña. Método para su represión. (Sugar cane mosaic. Method for its control.) La Vida Agrícola, Lima, Perú **5**(50): 89–98, 1928.

El mosaico de la caña de azúcar. (Sugar cane mosaic.) Est. Expt. Agric. de la Soc. Nac. Agraria de Perú. Circ. **10**, 23 p., 1928.

Conference before the Engineers' Society of Perú. The author describes the disease and reviews the work done to eradicate it. He advises the planting of immune or resistant varieties.

Macbride, Thomas Huston, & Smith, C. L.

Nicaraguan myxomycetes. Iowa Univ. Bull. Lab. Nat. Hist. **2** (4): 377–383, **4**(1): 73–75, 1896.

Madariaga, A.

Plagas y enfermedades del maíz. (Diseases and pest of corn.) Rev. Agric. (México) **4**: 449–456, 1919.

A discussion of *Puccinia* and *Ustilago maydis* on Indian corn.

Magalhaes, Octavio
Formas anomalas do *Oidum* "Brasilienses". Bol. Inst. Brasil Sci. **2**(10): 338–342, 1926.

Magnus, Paul Wilhelm
Über dei parasitische Pilze Argentinius (On the parasitic fungi of Argentina). Hedwigia **48**: 147–151, 1908.

Maire, Renó
Champignons de Sao Paulo (Brésil).—I. (Fungi from Sao Paulo, Brasil—I.) Ann. Mycol. **6**: 144–153, 1908.

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Nouvelles recherches sur les *Plasmodiophoracées*. (New investigations on the *Phasmodiophoraceae*.) Ann. Mycol. **9**: 226–246, 1911.

Mann, C[harles] W[illiam]
The handling of Puerto Rican oranges, grapefruits and pineapples. Puerto Rico Ins. Expt. Sta. Bull. **7**, 36 p., 1914.

Marchionatto, Juan B.
Nueva contribución al conocimiento de los hongos parásitos de las plantas cultivadas. (New contribution to the study of the parasitic fungi of cultivated plants.) Rev. Fac. Agron. Univ. La Plata III, **15**: 7–21, 1924.

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Fitoparásitos de la Argentina nuevos o poco conocidos. (New of little known plant parasites from Argentine.) Physis **8**: 367–372, 1926.

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Las enfermedades económicas de nuestros árboles frutales. (Economic diseases of our fruit trees.) Primera conferencia Nacional de Fruticultura, Feb. 28 a Mar. 2, Dolores (Córdoba) **1926**: 97–103, 1926.

A discussion of diseases in Spain.

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El "bitter-pit" de la manzana. (Bitter-pit of apple.) Rev. Centro Estud. Agron. y Vet. Univ. Buenos Aires. **20**(132): 325–328, 1927.

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Una fitonosia nueva (La "Koleroga" del café). (The koleroga of coffee.) Physis **8**(31): 554–557, 1927.

A description of this disease which is caused by *Corticium koleroga*. This fungus attacks *Ilex paraguayensis* and *Nerium oleander* in Argentina.

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Fitoparásitos de la Argentina nuevos o pocos conocidos. II (New or little known plant parasite from Argentina, II.) Rev. Fac. Agron. Univ. Nac. La Plata. 18: 21–29, 1928.

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La presencia de la *Plasmodiophora brassicae* en la República Argentina. (The occurrence of *Plasmodiophora brassicae* in the Argentine Republic.) Physis, Rev. Soc. Argentina de Cienc. Nat. **9**: 455–456, 1929.

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La lucha contra el "carbón volador" del trigo. (The fight against the "loose smut" of wheat.) Argentina, Bol. Min. Agric. **28**(2) : 229–231, 1929.

Brief notes on the treatment of loose smut of wheat caused by *Ustilago tritici* (Pers.) Jens.

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Las "fusariosis" del trigo y del maíz. Wheat and corn fusariosis.) Argentina Bol. Mins. Agric. **30**(3) : 189–192, 1931.

Discussion of fusariosis on wheat and corn.

————————
Dos informes sobre la roya "amarilla" del trigo. (Report on the yellow rust of wheat.) Argentina Mins. Agric. **836**, 20 p., 1931.

Brief report on this rust with lengthy tables on its distribution in Argentina.

————————
Notas críticas sobre la presencia de la "*Puccinia glumarum*" en la República Argentina. (Critical notes on the occurrence of *Puccinia glumarum* in the Argentine Republic.) Physis **10**: 362–367, 1931.

————————
Sobre algunos hongos parásitos de las gramíneas tóxicas para el ganado. (Some parasitic fungi of graminaceae toxic to live stock. Bol. Min. Agric. Nac. Buenos Aires, **29**: 457–462, 1931.

————————
La roya amarilla del trigo en la zona central. (The yellow rust of wheat in the central zone.) Bol. Min. Agric. Nac. Buenos Aires **30**(4) : 215–218, 1931.

The author states that as in other cereal producing countries, yellow rust of wheat, *Puccinia glumarum* is the first to appear in Argentine, followed by yellow rust *P. triticina* and then by black rust *P. graminis*. Among the grass hosts of *P. glumarum* are *Bromus unioloides* and *Hordeum jubatum*.

————————
La presencia de la roya "amarilla" (The presence of the "yellow" rust.) Min. Agric. Nac. (Buenos Aires) Sec. Prop. & Inform. Circ. **836**: 3–5, 1931.

A brief, popular account of the symptoms and life history of yellow rust of wheat caused by *Puccinia glumarum*. Data on susceptibility of varieties and distribution.

————————
Las "helmintosporiosis" de la cebada en la República Argentina. (The helminthosporioses of Barley in the Argentine

Republic.) Physis, Rev. Soc. Argentine Cien. Nat. **11**(38): 107–114, 1932.

Notes are given on the symptoms an etiology of three barley diseases occurring in Argentine. (*Helminthosporium teres, H. gramineum* and *H. sativum.*) Brief descriptions of the organisms are included.

————————— Notas sobre algunos *Sclerotium* parásitos de las plantas económicas. (Notes on some *Sclerotium* parasitic of economic plants.) Physis **11**: 301–305, 1933.

————————— Notas de patología vegetal. Contribución al conocimiento de las enfermedades de las plantas provocadas por los hongos. (Notes on plant pathology. A contribution to the knowledge of the plant diseases induced by fungi.) Rev. Fac. Agron. Univ. Nac. La Plata **19**(3): 407–426, 1933.

Notes are given of several fungous diseases of crop plants observed in the Argentine Republic for the first time.

————————— Enfermedades del trigo poco conocidas y radicudas en la región oeste de la zona triguera. (Little known wheat diseases indigenous to the western section of the wheat growing area.) Argentinie Min. Agric. (Buenos Aires) Bol. **36**(4): 293–299, 1934.

The following fungi were isolated from diseased wheat in Argentine since 1929. *Gibberella saubinetti, Helminthosporium sativum, Ophiobolus graminis, Alternaria peglionii, Fusarium moniliforme* var. *subglutinans.*

—————————, **& Millán, Roberto**

Certificación de la "semilla" de papa. (Potato "seed" certification.) Argentine, Bol. Min. Agric. (Buenos Aires) **36**(4): 301–302, 1934.

Brief account of quarantine measures, in Argentine, Brazil and Uruguay for the exclusion of potato diseases with special reference to those of virus origin. Other provisions are mentioned in regard to *Phythophtora infestans, Actinomyces scabies* and *Corticium vagum.*

————————— **Argentine Republic: the overwintering stages of pear and apple scab. Int. Bull. Plant Prot. 9(1): 1–2, 1935.**

Notes are given on the prevalence of apple and pear scab, where the perithecial stage of the two causal organisms (*Venturia inaequalis* and *V. pirina*) was observed for the first time in 1934.

————————— **Degeneración de la papa en los cultivos del país. La Chacra (Buenos Aires) 5(60): 48, 58, 71, 1935.**

————————— **Argentine Republic: yellow rust in the wheat-growing region.**

Behaviour of the cultivated varieties vis-a-vis the disease. Int. Bull. Plant. Prot. **9**(4) : 79–80, 1935.

Regional studies of the distribution of yellow rust (*Puccinia glumarum tritici*) in Argentine.

Argentine Republic: Species of *Fusarium* existing in the country. Int. Bull. Plant Prot. **9**(6) : 125, 1935.

Review of study of *Fusarium* occurring in Argentine made by O. Carrera.

Argentine Republic: new studides on the "lepra explosiva" of the orange. Int. Bull. Plant Prot. **9**(8) : 173–175, 1935.

The author discusses the etiology of the citrus disease known in Argentine as "Lepra explosiva". He concludes that the evidence is that *Amylirosa aurantium* and *Cladosporium herbarum* var. *citricolum* are not responsible for the maladies. He also excludes physiological factors, based on experiments, and is inclined to believe that the disturbance is due to a virus. He recognized two forms of the disease and observed that it facilitates the infections of *Colletotrichum gloeosporiodes* and other pathogens. Measures of control are under study.

Marins Ramos, C. S.

O combate do mosaico (The fight against mosaic.) Bot. Agric. Bahia (Brazil) **15**: 29–33, 63–65, 1926.

Novo methodo para combatir apropagacao de "mosaico na canna de assucar". (New method of fighting the propagation of "mosaic of sugar cane".) Bol. Min. Agric. Ind. e Comm. Brazil **15**: 793–795. (Correio Agric. Soc. Bahiana Agric. **4**: 199–201, 1926.

This paper on Alfaro's studies on the migration of *Aphis maidis* and recommends planting so that the cane can make a maximum growth before the period of migration.

Marsh, R. W.

Inoculation experiments with *Nematospora gossypii*, Ashby & Nowell. Ann. Bot. **40**(160) : 883–889, 1926.

Greenhouse tests showed that the fungus could not infect mature cotton hairs or bolls that were not wounded. *N. Coryli* and *Spermophthora gossypii* were shown to be parasites of injured bolls.

Marshall, R. C.

Observations on cypre (*Cordia alliodora* L.) in Trinidad with special reference to canker disease. (*Puccinia cordia* (P. Henn.) Arthur.) Part II. Silviculture. Mem. Imp. Coll. Trop. Agric. Trinidad **3**: 7–8, 1930.

Discusses the "cypre" (*Cordia alliodora* L.) as a forest tree with special reference to the canker disease caused by the parasitic rust fungus *Puccinia cordiae* (P. Henn.) Arthur, and gives control measures.

Martínez, Augusto N.

Una enfermedad del cacao. Quinta Normal, Estac. Expt. (Ambato, Ecuador) Circ. **6**, 13 p., 1916.

Cacao diseases in Ecuador. Soc. paper 676. Proc. Agric. Soc. of Trinidad and Tobago. **17**(1) : 28–36, 1917.

Popular. Cause not given.

La *Hemileia vastatrix* del café. (The *Hemileia vastatrix* of coffee.) Quinta Normal, Ambato (Ecuador) Circ. **15**, 5 p., 1923.

Martínez, L.

Enfermedad del cacao y medios de combatirlas. Bol. Circ. Gen. Agric.. (México) Rev. Agric. **2**(6) : 520–532, 1912.

Martínez García, Manuel

Catálogo de la flora y fauna del Estado de Oaxaca. (Catalog of the flora and fauna of the State of Oaxaca.) México, Imprenta del Estado, Oaxaca, México Part. **2**, 116 p., 1891.

Martins, K. F. P. von

Dexas plantarum mycetoidearum quas in itinere Brasiliensi observavit C. Ph. a Martins Nova Acta Acad. Coes Nat. Cur. **10** : 502–512, 1821.

Martyn, E[ldred] B[ridgeman]

The *Sclerotium* disease of coffee and its occurrence in this colony. Agric. Journ. Brit. Guiana. **2**(1) : 7–10, 1929.

The fungus is *Sclerotium coffeicolum.* Attacks Liberian coffee. Also Robusta, Uganda and Moca. Has been found on *Canephora deweveri* (a tree), *C. arabica* and *Cecropia peltata.* The author describes the symptoms and gives methods of control.

Mosaic disease of cane. Agric. Journ. Brit. Guiana. **2**(2) : **112**, 1929.

A brief note.

The gumming disease of sugar cane. Agric. Journ. of Brit. Guiana. **2**(3) : 208, 299, 1929.

A note.

The pokkah-bong and twisted top diseases of sugar cane. Agric. Journ. Brit. Guiana. **2**(3) : 209, 210, 1929.

A note.

Botanical and mycological division. Agric. Journ. of Brit. Guiana. **2**(4) : 222–224, 1929.

Mentions *Sclerotium coffeicolum* on coffee. A wilt of coffee resembling phloem necrosis of Surinam. *Cercospora coffeicolum* of coffee. Damping off of citrus seedlings.

Witch-broom disease of cacao and its control. Agric. Journ. Brit. Guiana. **2**(2) : 109–110, 1929.

A review of paper by this title written by Stell. Bull. Dept. Agric. Trinidad & Tobago 21 (Part 3), 1928.

The *Sclerotium* disease of coffee: Some notes on the origin of the disease its outbreak, and control. Agr. Journ. Brit. Guiana **3**(1) : 28–34,1930. (Trop. Agric. (Trinidad) **7**(6) : 165, 1930.)

Continuation of previous work given additional details from those in the above citation.

British Guayana: Erste Feststellung von *Fusarium cubense* in der Kolonia. Int. Auz. Pflanzenchutz **4**: 106, 1930.

Botanical and Mycological Division. Annual Report 1929. Agric. Journ. Brit. Guiana. **3**(4) : 226–233, 1930.

This report states that mosaic disease of sugar cane is not yet known in British Guiana. Gives brief notes of several diseases of crop plants.

British Guiana: *Fusarium cubense* discovered in the colony for the first time. Internal Bull. of Plant Protect. **4**(7) : 101–102, 1930.

The disease detected on wilted plantains. *(Musa paradisiaca.)*

Plant diseases. Agric. Journ. Brit. Guiana. **4**(2) : 95–100, 1931.

Notes on several common diseases.

Report of the Botanical and Mycological Division for the year 1932. Divisional Repts. Dept. of Agric. British Guiana **1932**: 117–121, 1932.

This report mentions mosaic and *Fusarium moniliforme* on sugar cane, *Acrothecium lunatum,* and *Clasterosporium punctiforme* on rice, and phloem necrosis on coffee.

Botanical and mycological investigations. British Guiana Admin. Rept. Director Agric. **1931**: 28–29, 1932.

Reports a non infectious chlorosis of sugar cane.

Preliminary list of diseases of economic plants in British Guiana. Kew. Bull. Misc. Inf. **1933**: 107–110, 1933.

Notes on some diseases of local economic plants and their relation to environment. Agric. Jour. British Guiana. **4**(2) : 95–100, 1931.

Brief notes. Most important is *Fusarium cubense.*

Note on diseases of rice. Dept. Agric. Brit. Guiana Rice, Bull. 1. Part IV, 1934.

A brief note listing *Tilletia horrida* Tak., *Sclerotium oryzae* Catt., *Fusarium moniliforme* sp., and *Gibberella* (*Lisea*) *Fujikuroi* (Saw.) Wr.

Report of the Botanical and Mycological Division for the year 1932. British Guiana Dept. Agric. Divisional Rpts. **1932**: 117–121, 1934.

A note on plantain and banana diseases in British Guiana with special reference to wilt. Agric. Journ. Brit. Guiana. **5**(2): 120–123, 1934.

This article confirms the presence of banana wilt due to *Bacterium solanacearum* in the Colony and its similarity to that disease known as "moko" in Trinidad. The symptoms of the disease are discussed.

Report of the Botanical and Mycological Division for the year 1933. British Guiana Dept. Agric. Divisional Repts. **1933**: 105–111, 1934.

Several diseases of more or less importance are reported.

Report of the Botanical and Mycological Division for the year 1934. British Guiana Dept. Agric. Div. Rpt. **1934**: 105–108, 1935.

Among the items mentioned in this report are citrus scab (*Sporotrichum citri*); a wilt of coconut trees; cacao witches' broom (*Marasmius perniciosus*); pineapple "black eye" disease and guava sun crack of fruits.

The diseases of rice in British Guiana. Agric. Journ. Brit. Guiana **7**(2): 142–143, 1936.

The author reports the following diseases on rice in British Guiana: blast (*Piricularia Oryzae*); man rice (*Fusarium moniliforme*) Mildewed heads *Acrothecium lunatum* and *Claterosporium punctiforme*); a sclerotium disease (*Sclerotium Oryzae*), and bunt (*Tilletia horrida*)

Mason, E. W.

Annotated account of Fungi received at the Imperial Bureau of Mycology. List II, Fascicle I, 1928.

Mason, T. G.

Ligneous Zonation and die-back in lime (*Citrus medica* var. *acida*) in the West Indies. Sci. Proc. R. Dublin Soc. N. S. **17**: 25–31, 255–262, 1923.

The results of studies.

Massee, G[eorge]
Mycological notes II: Journ. Mycol. **6**: 178, 1891.
Records *Sarcomyces vinosa* Mass. as new genera and species from Venezuela.

Trichosphaeria, Massee, Ann. Bot. **7**: 515–532, 1893.

Coffee disease in Nicaragua. Bul. Roy. Bot. Gard. Trinidad **3**(20): 182, 1899.
Notes on *Stilbum flavidum* in Nicaragua with recommendations to use Bordeaux mixture to control it.

Coffee disease in New World. Roy. Bot. Gard. Kew. Bul. Misc. Inf. **8**: 337–341, 1909.
The author gives a detailed description of coffee leaves which is supposed to be known in Central and South America. For some years it was attributed to the fungus *Sphaerostilbe flavida.*

Exotic fungi. Roy. Bot. Gard. Kew. Bull. Misc. Inform. **1**: 1–6, 1910.

Fungi exotici XIII. Kew. Bull. Misc. Inf. p. 189–191, 1912.

Mathews, V. D.
Studies in the genus *Pithium.* North Carolina Univ. Press Pamph. p. 133, 1931.

Mathews, W. H.
The agricultural progress of the pomeroom between the years 1905–1917. British Guiana Journ. Bd. Agric. **12**(1): 6–10, 1919.
A brief report.

Matz, Julius
Algunas enfermedades del follaje en las plantas. (Foliage diseases.) Rev. Agric. Puerto Rico **2**(12): 624–625, 1919; **3**(7): 20–24, 1919.
Popular notes mentioning *Rhizoctonia, Pellicularia,* mildew, etc.

Algunas observaciones respecto a la sarna (scab.) del citro en Puerto Rico. (Some observations on citrus scab in Puerto Rico.) Rev. Agric. Puerto Rico **2**(3): 40–41, 1919.
Brief popular notes.

Citrus spots and blemishes. Puerto Rico Ins. Expt. Sta. Circ. **16**, 8 p., 1919.
Popular account of the most common diseases of citrus in Puerto Rico, suggesting in some instances method of control to preserve good appearance for the market.

Report of the division of plant pathology and botany. Puerto Rico Ins. Expt. Sta. Ann. Rpt. **1919**: 35–36, 1919.

Records of diseases of occurrence during the year.

Enfermedad de la raíz de la caña de azúcar. (Root disease of sugar cane.) Rev. Agr. Puerto Rico. **2**(3): 38–39, 1919.

Brief popular note. Attributes the cause to a *Rhizoctonia* and *Pythium*.

Infection and nature of the yellow stripe disease of cane. Journ. Dept. Agric. Puerto Rico. **3**(4): 65–82, 1919.

Results of experiments and histological studies. The author describes a granular plasma in some of the cells which he believes may be a cause of the disease.

Observaciones hechas en la región de Maricao con respecto a las enfermedades del café y del guineo. (Observations made in the region of Maricao in regard to the coffee and banana diseases.) Rev. Agric. Puerto Rico. **5**(5): 15–18, 1925.

Brief report of a trip to the coffee district of Maricao, (Puerto Rico). The author gives his observations on coffee and banana diseases.

Pudrición de la base de la "roselle". (Rot of the base of roselle.) Rev. Agric. Puerto Rico. **5**(5): 18–20, 1920.

Popular.

Últimos desarrollos en la patología de la caña de azúcar. (Last development in the pathology of sugar cane.) Insular Expt. Sta. Puerto Rico. Circ. **33**: 32–36, 1920.

Paper read before the Sugar-cane Technologists' Association of Puerto Rico. Reviews the work done in sugar-cane pathology and devoted special attention to mosaic disease.

Gumming disease of sugar cane in Puerto Rico. Phytopathology (Abstract) **10**(9): 429, 1920.

Investigations of root disease of sugar cane. Journ. Dept. Agric. Puerto Rico **4**(1): 28–40, 1920.

A thorough discussion of the subject, giving results of experiments on observations on *Marasmius, Rhizoctonia, Pythium* and *Trichoderma* spp.

El mal del guineo. (Banana wilt.) Ins. Expt. Sta. Puerto Rico. Circ. **25**, 7 p., 1920. (La Hacienda **20**: 43–45, 1925.)

The gumming disease of sugar cane. Facts About Sugar. **15**: 258–259, 1922.

Popular.

Citrus and pineapple fruits rots. Puerto Rico Ins. Expt. Sta. Bull. **24**, 1920.

A new vascular organism in sugar cane. Journ. Dept. Agric. Puerto Rico **4**(1): 41–46, 1920.

Short paper describing *Plasmodiophora vascularum* Matz.

Report of the Division of plant pathology and botany. Puerto Rico. Ins. Expt. Sta. Ann. Rpt. **1919–20**: 91–93, 1920.

Gumming of sugar cane in Puerto Rico. Sugar **22**: 282–283, 1920.

A description and history of the disease.

La gomosis de la caña de azúcar. (Gumming disease of sugar cane.) Sugar **22**: 363–364, 1920.

Spanish translation of an earlier publication.

Observaciones en la gomosis de la caña en Puerto Rico. (Observations on gummosis of sugar cane in Puerto Rico.) Rev. Agric. Puerto Rico **6**(4): 33–39, 1921.

Popular.

El salcocho de los semilleros de tabaco. (Damping–off of tobacco seed beds.) Puerto Rico. Ins. Expt. Sta. Circ. **55**, 6 p., 1921.

Popular account giving cause and methods of control.

Annual Report of the Division of Plant Pathology and Botany for the year 1920–21. Puerto Rico Ins. Exp. Sta Ann. Rept. p. 51–58, 1921.

La enfermedad de la raíz de la caña de azúcar. (Sugar cane root disease.) Puerto Rico Ins. Expt. Sta. Circ. **56**, 12 p., 1921.

Popular discussion of this complex subject.

Una enfermedad dañina de la habichuela. (A harmful disease of beans.) Puerto Rico Ins. Expt. Sta. Circ. **57**, 8 p., 1921.

The disease is caused by *Rhizoctonia microsclerotia.*

The Rhizoctonias of Puerto Rico. Journ. Dept. Agric. Puerto Rico **5**(1): 2–30, 1921.

Annual Report for the Division of Plant Pathology and Botany for the year 1920–21. Ins. Expt. Sta. Puerto Rico. Ann. Rpt. **1920–21**: 52–53, 1921.

La enfermedad de la raíz en el café. (Root disease on the coffee.) Est. Expt. Ins. Puerto Rico. Circ. **32**, 10 p., 1920.

A popular description of the coffee root disease caused by the fungus *Rosellinia* sp.

Gumming disease of sugar cane. Journ. Dept. Agric. Puerto Rico **6**(3) : 5–21, 1922.

This paper gives the results of the first studies on this disease in Puerto Rico. The author tells of the finding of the disease, gives something of the economic considerations and varietal resistance.

La gomosis de la caña de azúcar. Puerto Rico Ins. Expt. Sta. Circ. **20**, 8 p., 1922.

Popular discussion of the preceding.

Observaciones sobre la gomosis de la caña en Puerto Rico. (Observations on the gummosis of sugar cane in Puerte Rico.) Rev. Agric. Puerto Rico **8**(4) : 5–14, 1922.

Popular.

La gomosis de la caña. (Gummosis of sugar cane.) Sugar **24**: 352–354, 1922.

Popular.

Dry top rot of sugar cane. A vascular disease. Journ. Dept. Agric. Puerto Rico **6**(3) : 28–47, 1922.

Description of the disease and experimental results. *Phytophthora vascularum* Matz.

Informe de la Estación Experimental Insular. Informe de la Div. de Botánica y Patología. (Report of the Div. of Botany and Pathology.) Rev. Agric. Puerto Rico. **8**(2) : 63–65, 1922.

Contains reports on gumming disease, *Plasmodiophora* disease, mosaic of sugar cane and minor diseases of other crops.

Recent developments in the study of the nature of mosaic diseases of sugar cane and other plants. Journ. Dept. Agric. Puerto Rico. **6**(3) : 22–27, 1923.

The author reviews the work of Iwanowski, Kunkel and Palm on the intracellular bodies.

Recientse investigaciones en el estudio de la naturaleza del mosaico de la caña de azúcar y otras plantas. (Recent investiga-

tions on the studies of the nature of mosaic disease of sugar cane and other plants.) Rev. Agric. Puerto Rico. **9**(4): 9–12, 1922.

Popular discussion of an article that appeared in Journ. Dept. Agric. Puerto Rico. 6(3): 22–27, 1923. (Preceding citation.)

Naturaleza del mosaico de la caña. (Nature of the mosaic disease of sugar cane.) Sugar **25**: 222–223, 1923.

A discussion of bodies found in mosaic plants.

Root knot of sugar cane in Puerto Rico. Facts About Sugar, **11**: 93–94, 1925.

A popular discussion.

Root knot on sugar cane in Puerto Rico. Phytopathology **15** (9): 559–563, 1925.

Maublanc, André

Espéces nouvellew de champignons inférieurs. (New species of lower fungi.) Bull. Soc. Mycol. France, **20**: 165–171, **21**: 87–94, 1905.

Sur une maladis des feuilles du papayer. "*Carica Papaya.*" (On a disease of the leaves of *Carica papaya.*) A Lavoura. **16**: 208–212, 1913. (The same paper is published also in Portuguese under the title "Sobre uma molestia do mamoeiro (*Carica Papaya* L.) A Lavoura **16**: 204–208, 1913.)

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Alguna fungos do Brasil novos on mal conhocidos. (Some fungi of Brasil new or badly known.) A Lavoura **18**: 19–32, 1914.

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Le *Stilbum flavidum* Cooke, parasité du Caféier et sa place dans la clasification. (The *Stilbum flavidum* Cooke, coffee tree parasite and its place in the classification. (Comp. Rend. Hendom. d. Seances d l'Acad. Sci. de Paris **127**, 1913. (Rev. Min. Agr. & Com. Bogotá Vol. *II*, 1916.)

Contribution á l'étude de la flora mycologique brasiliene. (Contribution to the study of the mycological flora of Brazil.) Bull. Soc. Mycol. France. **36**: 33–43, 1920.

Observations sur quelques champignons du Bresil. 1. Sur un parasite des feuilles de *Mikania*. Observations on some fungi from Brazil. I. on a parasite of the leaves of *Mikania*.) Arch. Bot. Bull. Mens. **2**: 121–129, 1928.

May D[avid] W[illiam]

Diseases of cane. Puerto Rico Agric. Expt. Sta. (Mayagüez) Bull. **9**: 38–39, 1910.

Kavangire in Puerto Rico. (A reply to E. W. Brandes.) Facts About Sugar **21**: 522, 1926.

Controversial.

Kavangire in Puerto Rico. (A reply to F. S. Earle.) Facts About Sugar **21**: 1096, 1926.

Controversial.

Mayor, Eugenio

La mancha de "los cafetos en el Departamento de Cundinamarca". (The coffee tree spot in the Department of Cundinamarca.) Rev. Nac. Agric. (Bogotá) **6**: 135–152, 1911.

The author attributes the yellowing of coffee in the Department of Cundinamarca (Colombia) to the fungus *Hemileia vastatrix.* He believes that it has been confused with *Stilbella flavida* Cooke. He gives description of both fungi and means of control.

El amarillamiento de los cafetos en el Departamento de Cundinamarca. (The yellowing of coffee in the Department of Cundinamarca. Rev. Nac. Agric. (Bogotá) **6**: 331–340, 1912.

The author attributes the yellowing of coffee in the Department of Cundinamarca (Colombia) to the fungus *Phthora vastatrix* D'Herelle. He describes the disease and recommends burning of infested trees as a control measure.

Contribution a' l'étude des uredinées de Colombia. In Fuhr. mann, O. Voyage d' exploration Scientifique en Colombia. Mem. Soc. Nenchat. Sci. Nat. **5**(2): 442–599, 1914.

McCallan, E[rnest] A[lbert]

Report of seed potato inspection. Bermuda Agric. Dept. Agric. Bull. **1922**: 4–7, 1922.

A record of the amount of leafroll and mosaic in plants grown from the same stock in Bermuda and Nova Scotia.

Bermuda: Eine Krankheit der *Lilium longiflorum* und die "Aster yellows". (Bermuda: A disease of *Lilium longiflorum* and the aster yellows.) Inst. Anz. Pflanzenschutz **1**: 65, 1927.

McClelland, Tomás B.

The coffee leaf spot (*Stilbella flavida*) in Puerto Rico. Puerto Rico Agric. Expt. Sta. (Mayagüez) Bull. **28**, 12 p., 1921. (Spanish ed. 9 p. 1922.)

This fungus attacks *Coffea arabica, Bryophyllum calycinum, Andira inermis, Inga vera, Citrus* and other plants. Gives suggestions for its control.

-------------, & **Tucker, C[larence] M[itchell]**
Green scale *Coccus viridis,* a new pest in coffee and citrus. Agric. Notes (Mayagüez) Puerto Rico. No. **48**, 2 p., 1929.

Attacked by two fungi, one of which has been identified as *Cephalosporium lecanii.*

Mc Kenney, R[andolph] E[vans] B[ender]
The Central American banana blight. Science n. s. **31**(802) :750, 751, 1910.

Medina, Vicente
El control de enfermedades y plagas en los semilleros y víveres de café. (Control of diseases and pests in the coffee seed beds and nurseries.) Bol. Agr. (Puerto Rico.) Dept. Agric. **1**(7) : 2–3, 1931.

The author discusses in popular style the subject of coffee diseases in seed-beds.

Mejía F. Ramón
La arachnosis del cafeto. (Coffee tree arachnosis.) Rev. Cafetera de Colombia, **3**(28–29) : 1043–1045, 1931.

The author believes that two causes are responsible for this trouble (1) Climatic conditions and the position of the groves that prevent the use of shade trees. (2) The invasion of an Arachnidae (not determined). He describes the organism and suggests spraying (300 grams of common soap, 100 grams of creolin and water to make 20 liters) to control it.

Menéndez Ramos, R[afael]
El suelo no puede ser responsable del matizado de la caña. (The soil can not be responsible for the mottling of sugar cane.) Rev. Agric. Puerto Rico. **11**(3) : 13–20, 1923.

The soils is not the cause of the disease. A thorough discussion.

Sigamos con el matizado. (Let us continue with the mottling disease.) Rev. Agric. Puerto Rico. **11**(5) : 23–28, 1923.

Popular discussion giving further data to the preceding.

Sugar cane disease. Ins. Expt. Sta. Puerto Rico. Ann. Rpt. **1922–23** : 21–22, 1923.

A brief record.

La cal como enmienda. (Lime as an amendment.) Ins. Expt. Sta. Puerto Rico. Circ. **74**, 17 p., 1923.

Discussion on the agricultural uses of lime. The author discusses the popular belief that lime is a cure of sugar-cane mosaic. He declares that lime is not a cure for the disease.

Estudios sobre el mosaico de la caña. Movimiento del virus a través del tallo en el caso de infecciones secundarias. (Studies on sugar cane mosaic disease. Movement of the virus through the stalk in cases of secondary infections.) Rev. Agric. Puerto Rico. **13**(4): 219–226, 1924. (Rev. Appl. Mycol. **4**: 244. Louisiana Planter & Sugar Manuf. **73**(25): 488–489. Rev. Agric. Com. & Trab. Cuba **7**(5): 31–33, 1925.)

All the cuttings from a stalk of cane on which only a part of the leaves are mottled, will probably produce diseased plants.

Mosaic disease and method of control. Planter & Sugar Manuf. **75**(25): 487–498, 1925. (Rev. Appl. Mycol. **5**: 329, 1925.)

A popular discussion of the subject.

La enfermedad mosaico y los métodos de combatirla. (The mosaic disease and method to control it.) El Mundo Azucarero **13**(8): 241–245, 1926.

A translation of the previous citation. Planter & Sugar Manuf. 75: 487–489, 1925.

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Cercosporae de Minas Geraes (*Cercosporae* from Minas Geraes) (Brazil) Arq. Inst. Biol. Veg. **1**(3): 213–220, 1935.

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Murrill, William Alphonse

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The Agaricaceae of tropical North Americana. VIII. Mycologia **10**(1) : 15–33, (2) : 62–85, 1918.

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Cuban Polypores and Agarics. Mycologia **11**(1) : 22–32, 1919.

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A new *Bolete* from Puerto Rico. *Gyroporus Earlei* sp. nov. Mycologia **13**(1) : 60–61, 1921.

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Light-colored resupinate—Polypores—III. Mycologia **13**(2): 83–100, 1921.

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Venezuela, Puerto Rico.

Myers, J[ohn] G[olding]

Dry-season studies of cane Homoptera at Soledad, Cuba. Contrib. Harvard Inst. Trop. Biol & Med. **3**: 69–110, 1926. (Rev. Appl. Ent. ser. A. **14**: 497–498, 1926.)

It refers to mosaic disease of sugar cane and corn; its transmission and spread.

Source of witch-broom infection believed to be wild cacao in Suriname. West Indian Com. Circ. **45**(618): 43–44, 1930.

Observations on a journey from the mouth of the Amazon to Mt. Roraima and down to cattle-trail to Georgetown. Agric. Journ. Brit. Guiana **5**(2): 86–100, 1934.

In that trip it was observed that cacao was heavily infected with witches' broom, caused by the fungus *Marasmius perniciosus*, which apparently has not been reported from the Amazon region before.

Observations on wild cacao and wild bananas in British Guiana. Trop. Agric. (Trinidad) **11**(10): 263–267, 1934.

In this account of his journey in the Amazon Basin in 1932 the author states that the complete absence of witches' broom disease (*Marasmius perniciosus*) in the wild cacao he saw in the Kanuku mountains was in marked contrast to the badly diseased condition of the wild cacao he had previously observed in the Coppename river, in the interior of Dutch Guiana, with which the Kanuku cacao is obviously identical. Seedlings of the Coppename plants are now growing at the College grounds and at Kew and are of the type which Pittier and others consider to be distinct species (*Theobroma leicarpa*). Notes are also given on wild bananas and plantains which the author found during his journey, including a reference to Sir Robert Schomburgk's statement that during his travels (1835–39) in Guiana he observed on the coast of British Guiana a peculiar disease in *Musa* plantations, which starts from the innermost vascular bundles which take a brownish color intermixed with a number of black spots. This is believed to be probably the first reference to Panama disease (*Fusarium oxysporum cubense*) or something very similar. (e. g. bacterial wilt—*Bacterium solanacearum*.)

Navarro, A.

Enfermedades de la papa en México. (Potato diseases in México.) Agricultura (México) **1**(5): 335–338, 1934.

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Negretti, A. N.
Tratamientos contra las enfermedades del cacao. (Treatment of cacao diseases.) Rev. Agric. República Dominicana **17** (12): 188–192, 1923.
A report on a root disease due to *Rosellinia pepo*. Popular discussion giving symptoms, description of the disease and control.

Nieves, Raimundo
Contribución al conocimiento de la "caries" del trigo (*Tilletia* spp.). Contribution to the knowledge of the smuts of wheat. *Tilletia* spp.) Argentina Bol. Minis. Agric. **29**(1): 97–110, 1930.
Discussion on the biological characters, genetic behavior and bases for the creation of new resistant varieties.

Ensayos comparativos de resistencia a la *Tilletia laevis* (Kühn) con Trigos Argentinos e importados, comunes y de "pedigree". (Comparative trials of resistance to *Tilletia laevis* (Kühn) with common and pedigree Argentine and imported wheats.) Bol. Min. Agric. Nac. (Buenos Aires), **29**(3): 297–316, 1930.
A study of varietal resistance to the fungus *Tilletia leavis*.

Resistencia comparativa a la *Tilletia levis* Kühn, del Trigo en la Argentina. (Comparative resistance of wheat to *Tilletia levis* (Kühn) in the Argentine.) Phytopathology **21**(7): 705–727, 1931.
Experimental studies.

Las caries o carbón hediondo del trigo. (Caries or foul smut of wheat.) Bol. Mens. Min. Agric. Argentina. **32**: 397–411, 1933.

Estudios sobre la especialización fisiológica de las caries del trigo. (*Tilletia tritici* y *Tilletia levis*) Argentina. (Studies on the physiological specialization of the smut of wheat in the Argentine.) Guatraché Expt. Sta. Ann. Rpt. **1932**: 1–108. 1933.

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Estudios sobre la distribución y prevalencia relativa de la *Tilletia tritici* y *T. levis,* en el sudeste de La Pampa, en 1932. (Studies on the distribution and relative prevalence of *Tilletia tritici* and *T. levis* in the South east of La Pampa, in 1932.) Bol. Mens. Min. Agric. Argentina **35**(1–3): 79–101, 1933.
A detailed report of the writers' studies on the bunt disease of wheat. Tabulations are given on the distribution and prevalence of *Tilletia tritici* and *T. laevis*.

Nota preliminar sobre un probable híbrido natural. (*Avena byzantina* x *A. fatua*) atacada por *Ustilago levis*. (Preliminary note on a probable natural hybrid (*Avena byzantina* x *A. fatua*) attacked by *Ustilago levis*.) Argentine, Bol. Mins. Agric. **36**(1) : 71–79, 1934.

Discussion and account on the subject, giving his observations.

Infección experimental del centeno de Pet Kus (*Secale cereale* v. *vulgare*) por las caries del trigo *Tilletia tritici* (Bjerk.) Wint y *Tilletia levis* Kühn. (Experimental infection of Pet kus rye (*Secale cereale* var. *vulgare*) by the smut of wheat *Tilletia tritici.* (Bjerk.) Wint. & *T. levis* Kühn.) Argentina, Bol. Mins. Agric. **36**(4) : 347–359, 1934.

Experimental record.

Infección experimental del centeno de Petkus (*Secale cereale* v. *vulgare*), por las caries del trigo: *Tilletia tritici* and *Tilletia levis.* (Experimental infection of rye var. Petkus (*Secale cereale* var. *vulgare*) by wheat bunt *Tilletia tritici* and *T. levis.*) Phytopathology **25**(5) : 503–515, 1935.

Report of experimental results obtained in artificial infection of rye with wheat bunt disease. (*Tilletia tritici* and *T. laevis.*)

Genética de la resistencia a la "carie" (*Tilletia tritici* raza. 5 M. A.), en la cruza Barleta x Florence (Cheg 27–10x) (Genetics of resistance to bunt (*Tilletia tritici* strain 5 M. A.) in the cross Barletta x Florence (Cheg 7–10x). Physis, Buenos Aires, **12**(4) : 51–63, 1936.

The author gives a detailed study on the hereditary nature of the character for resistance to bunt of certain wheat crosses.

Distribución y prevalencia relativa de la *Tilletia tritici* y *Tilletia levis* (caries del trigo) en la región de Guatraché. (The distribution and relative prevalence of *Tilletia tritici* and *T. levis* (wheat bunt) in the Guatrachá district.) Physis, Buenos Aires, **12**(41) : 64–70, 1936.

The author gives data on distribution, relative prevalence and economic importance of bunt of wheat in the wheat growing centers of La Pampa, Argentine.

Nolla, J[osé] A[ntonio] B[ernabé]

The anthracnoses of citrus fruits, mango and avocado. Journ. Dept. Agric. Puerto Rico, **10**(2) : 25–63, 1926.

The results of studies on *Colletotrichum gloeosporium* and *Gloeosporium limetticolum.*

Onion-leaf anthracnose. Journn. Dept. Agric. Puerto Rico. **10** (3–4): 245–256, 1926.

Discussion of a severe outbreak of a fungus on *Allium cepa*. He described the organism under the name of *Colletotrichum chardonianum*.

Mango wither-tip. Journ. Dept. Agric. Puerto Rico. **10**(3–4): 257–258, 1926.

A new disease which is caused by *Colletotrichum gloeosporioides*.

A new *Altenaria* disease of onion (*Allium cepa* L.) Phytopathology **17**(2): 115–132, 1927.

A description of the disease and methods of control.

The black-shank of tobacco in Puerto Rico. Journ. Dept. Agric. Puerto Rico **12**(4): 185–215, 1928.

A description of the disease which is caused by *Phytophthora nicotianae* and recommendation for its control.

The eggplant blight and fruit rot in Puerto Rico. Journ. Dept. Agric. Puerto Rico **13**(2): 35–57, 1929.

This disease is caused by *Phomopsis vexans*. The author describes the disease and the fungus and gives recommendations for its control.

Biologic control of the aphids *Rhopalosiphum persicae* Sulzer and *Aphis gossypii* Glover. Phytopathology (Abstract) **19**(1): 102, 1929.

El *Acrostalagmus Aphidum* Oud. en la lucha contra los áfidos. (*Acrostalagmus Aphidum* Oud. and Aphid control.) Mem. Real Soc. Española Hist. Nat. **15**: 9–12, 1929. (Journ. Dept. Agric. Puerto Rico **13**(2): 59–72, 1929.)

Studies on the bacterial wilt of the *Solanaceae* in Puerto Rico. Journ. Dept. Agric. Puerto Rico. **15**(3): 287–308, 1931.

A very complete study of this disease which is caused by *Bacterium solanacearum*.

Las enfermedades del tabaco en Puerto Rico. (Tobacco diseases in Puerto Rico.) Ins. Expt. Sta. Puerto Rico Bull. **39**, 29 p., 1932.

Popular account of the disease of most prevalence in Puerto Rico attacking tobacco. Most of them of fungus origin.

The damping-off of tobacco and its control in Puerto Rico. Journ. Dept. Agric. Puerto Rico **16**(2): 203–204, 1932.

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A variety of tobacco resistant to ordinary tobacco mosaic. Journ. Dept. Agric. Porto Rico **17**(4) : 301–303, 1933.

A preliminary report. The variety was introduced from Colombia, Valle del Cauca, in 1929, by the senior author.

Studies on disease resistance. I. A tobacco resistant to ordinary tobacco mosaic. Journ. Agric. Univ. Puerto Rico **19** (1) : 29–49, 1935.

A more detailed and thorough work than the preceding paper. The purpose of this paper is to present the results and observations on infection studies with the Ambalema variety of tobacco.

Nowell, W[illiam]

Report on a visit to St. Lucía . Agric. News **13**(310) : 94–95, 1924.

Fungoid and bacterial diseases. West. Indian Bull. **14**(4) : 209–216, 1914.

A list of diseases and geographical distribution.

The physiological affections of sea island cotton in the West Indies. West Indian Bull. **14**(4) : 304–317, 1914.

A discussion on curly-leaf and loggerhead.

Black root disease of limes. Agric. News **13**(327) : 364–365, 1914.

Observations made during a visit to Grenada, Feb.–March 1915. Report issued by the Colonial Secretary, Grenada, 1915.

Diseases of lime trees in forest districts. Imp. Dept. Agric. West Indies.. Pamphlet **79**, 41 p., 1915.

New light of the witch-broom disease of cacao. Agric. News **14**(352) : 382, 1915.

A history on the work on this disease and the results of recent work by G. Stahel, (Bull. 33) September 1915, in which he attributes the disease to a new species, *Marasmius perniciosus*.

Fungoid and bacterial diseases. West Indian Bull. **15**(2) : 133–143, 1915.

A list of diseases with distribution.

A stem disease of sugar cane in Barbados. Agric. New. **15**(357) : 14, 1916.

Brief popular note.

The internal disease of cotton bolls. Agric. News **15**(364): 126–127, 1916.

The author refers to an article in West Indian Bulletin, 14: 222–238 and then to specimens collected in Tortola, St. Kitts, Monserrat, St. Vincent and Barbados and to foreign literature.

A new fungous on the green scale. Agric. News **15**(375): 302, 1916.

A record of an undescribed fungus from Monserrat on *Coccus viridis (Lecanium viride).* It was sent to Thaxter who said it was closely related to *Empusa Fresenii* Nowak. He had received the same from Cuba. Johnston reported *E. Fresenii* on mealy bugs in Porto Rico (Bull. 10, Ins. Expt. Sta.)

Pink disease in the West Indies. Agric. News **15**(371): 238–239, 1916.

The author states that the material was determined by Rorer as *Corticium salmonicolor.* (Bull. Dept. Agric. Trinidad & Tobago 15(3).)

The small *Rosellina* on cacao. Agric. News. **15**(382): 414, 1916.

This note refers to West Indian Bulletin v. 16, No. 1. The author of that paper referred to an unidentified species of *Rosellinia* on cacao in Grenada and St. Vincent and on immortel in St. Lucia. A later report from Kew Botanic Garden says that this species has a very close resemblance to *R. paraguayensis* Starb. which was described from Paraguay in 1904.

Fungous and bacterial diseases. West Indian Bull. **16**(1): 17–25, 28–35, 1917.

A list of diseases with distribution.

Rosellinia root diseases in the Lesser Antilles. West. Indian Bull. **16**(1): 31–71, 1917.

Detailed account on *Rosellinia Pepo* Pat. and *R. bunodes* (B. & Br.) Sacc. Gives description, symptoms, distribution and control measures.

The fungi of internal-boll disease. West Indian Bull. **16**(3): 152–159, 203–235, 1917.

A discussion of this disease which the author attributes to *Eremothecium cymbalariae* Borzi.

The rind fungus of sugar cane. Agric. News **16**(387): 62, 1917.

This is a discussion of Johnston's paper in Vol. I, No. 1, of the Journal of the Board of Commissioners of Agriculture of Puerto Rico (Later Journ. Dept. Agric. of Puerto Rico and now Journ.

Agric. Univ. Puerto Rico.) It contains some historical data and the writer's opinion of this disease.

New records of entomogenous fungi in Barbados. Agric. News **16**(388) : 94, 1917.

The writer found *Verticillium heterocladum* on a species of citrus white fly; *Aschersonia* (*cubensis?*) on star scale (*Vinsonia*) and *Ophionectria coccicola* on purple scale (*Lepidosaphes*). All on leaves of lime trees in a deep gulley. The first has been reported in Puerto Rico, the third is common and useful in Dominica and St. Lucia and occurs in Grenada and St. Vincent.

Diseases of economic plants. West Indian Bull. **16**(4) : 309–310, 322–331, 1917.

A useful list.

The status and treatment of coconut bud rot. Agric. News **16** (385) : 30, 1917.

This note states that the disease destroyed a grove in Matanzas, Cuba, previous to 1886. It appeared in Baracoa as early as 1880. Heavy losses in Jamaica in 1891–1910, in Cayman Islands in 1891. Unconfirmed records from Santo Domingo and Haiti. Appears to be absent from Florida, Bahamas and Puerto Rico. Reports indicate that it is present in British and Spanish Honduras. Johnston reported that it was not present in Panama. In Trinidad in 1907. Small outbreaks in Grenada, St. Vincent and St. Lucia. Common in British Guiana and reported from Surinam.

---------- Sugar-cane diseases in Puerto Rico. Agric. News **16**(393) : 158, 1917.

A comment to the Fifth Annual Report (1916) of the Insular Experiment Station of Puerto Rico, written by John A. Stevenson.

---------- Bacterial diseases of tomatoes in St. Vicent. Agric. News **16** (409) : 414–415, 1917.

A report on wilt caused by *Bacterium solanacearum* E. F. S.

---------- Algal diseases (red rust) of cacao. Agric. News **17**(421) : 190, 1918.

This disease is due to *Cephaleuros virescens* Kunze (*C. mycoidea* Karst, *Mycoidea parasitica* Cunn.) Reported in St. Lucia in 1917. Previously reported in Trinidad by Rorer (Proc. Agri. Soc. Trinidad & Tobago v. 17.) Reported from Grenada in 1902. Known in St. Lucia and Dominica.

---------- Diseases of coconuts in Jamaica. Agric. News **17**(427) : 286–287, 1918.

This refers to two leaflets by Ashby. They discuss bud rot. The fungi involved are *Thielaviopsis paradoxa* and *Phytophthora* sp. The

forms are: (1) pineapple or leaf-bitten disease, (2) hard or little leaf-bitten disease, (3) *Phytophthora* leaf-bitten disease, and (4) Rhinoceros beetle leaf-bitten disease.

The ring or root disease of coconut palms. West Indian Bull. **17**(4): 189–202, 1918.

A history and symptoms of the diseases, the causal organism (nematode) and methods of control.

Root disease of coconut palms in Grenada. Agric. News **17**(434): 398–399, 414, 1918.

This note describes the symptoms but does not name an organism. The symptoms agree with those described by Stockdale for Trinidad and Tobago in 1906 and later by Rorer.

Fomes lucidus as a parasite of trees. Agric. News **17**(412): 46, 1918.

The author reports this fungus as attacking the Saman trees (*Pithecolobium Saman*) and the bread and cheese tree (*P. unguis-cati*) in the Botanic Garden of St. Kitts in 1914. He states that it is reported from Curacao as attacking *Caesalpinia coriaria* and *Acacia tortuosa* and in South Africa on *Acacia* spp. and *Acacia mollissima*. It has been reported previously on lime trees in Monserrat. (See West Indian Bull. 7: 493.)

Diseases of economic plants. West Indian Bull. **17**(2): 96–106, 1918.

A list of diseases with geographical distribution.

Eel-worm disease (Black head) of bananas. Agric. News **17** (422): 206, 1918.

Reported from Grenada on the coarse banana known as bluggoe. The disease is described. A similar disease has been reported from Jamaica by Ashby (Bull. Dept. Agric. Jamaica 2: 116) and attributed to *Tylenchus similis*.

Report on an investigation of froghopper pest and diseases of sugar cane in Trinidad. Bull. Dept. Agric. Trinidad & Tobago **18**(2): 57–69, 1919. (Trinidad & Tobago Council Paper No. 39, 1919.)

This paper contains brief reference to *Marasmius sacchari*, *Himantia stellifera*, *Odontia sacchari* and *O. saccharicola*. Also factors influencing root disease.

The red ring or root disease of coconut palms. West Indian Bull. **17**(4): 189–202, 1919.

A discussion of the history, symptoms and cause of this disease.

The red-ring disease of coconuts. Proc. Agric. Soc. Trinidad & Tobago. **19**(9–10) : 217–219, 1919. (Agric. Soc. Trinidad & Tobago Soc. paper **736**, 1919.)

A brief report on this disease which is caused by nematodes.

Foot rot or mal di gomma on limes. Agric. News **18**(439) : **62**, 1919.

This note refers to this disease on the island of Grenada, but does not explain cause.

A root disease of cacao in Trinidad, *Rosellinia pepo.* Trinidad & Tobago Dept. Agric. Bull. **18**(4) : 178–199, 1919.

A description of the disease, method of infection and control measures.

Disease of sugar cane. Agric. News. **16**(384) : 14, 1917.

The red-ring disease of coconut palms. West Indian Bull. **18** (1) : 73–76, 1920. (Trop. Agric. (Ceylon) **54**(4) : 240–245, 1920.)

A continuation of previous work mentioned above. (West Indian Bull. v. 17(4).)

Mosaic disease of sugar cane. Agric. News. **19**(462) : 14, 1920.

A review of the U. S. Dept. Agric. Bull. 829 by Brandes and Bull. 19 of the Insular Experiment Station of Puerto Rico by F. S. Earle.

Notes on the proclaimed diseases and pests. Bull. Dept. Agric. Trinidad & Tobago **19**(4) : 175–179, 1920.

Brief discussion of coconut bud rot, red ring of coconut, mosaic of sugar cane and anthracnose of lime.

Red-ring disease of coco-nuts. Agric. News **19**(475) : 222, 1920.

Recommendations for the disposition of infected material.

Root disease of cacao. Journ. Jamaica Agric. Soc. **24**(6–7) : 173–174, 1920.

A partial reprint from Bull. Dept. Agric. (Trinidad & Tobago) 18, 1920.

A disease of coco-nut. Imp. Dept. Agric. West Indies Rept. Agric. Dept. (St. Lucía) **1918–19** : 7, 1920.

Material received in bad condition but the organism was probably *Pythium* or a *Phytophthora.*

——————, & **Williams C. B.**
Sugar cane blight in Trinidad. Bull. Dept. Agric. Trinidad & Tobago. **19**(1) : 8–10, 1920.
These diseases are caused by *Marasmius* and *Odontia.*

A supposed nematodes disease of banana. West Indian Bull. **17**(3) : 177–179, 1919.
A brief discussion.

Infection of orange fruit through bug punctures. Agric. News **17**(418) : 142, 1918.
Believed to be due to fungous infections of puctures by insects.

Internal disease of cotton bolls in the West Indies, II. West Indian Bull. **17**(1) : 1–26, 1918.
The organism is *Nematospora* sp.

Mycologist's report on a visit to Trinidad. Proc. Agric. Soc. Trinidad **19**(6) : 141–159, 1919.
A discussion of root diseases of sugar cane in relation to injury caused by frog-hopper. Remedial measures are suggested.

Bracket fungi of lime trees and the critical period in the development of young lime trees. Rept. on the Agric. Dept. (Dominica) **1917–18** : 11–14, 1919.
A report on the small fungi *Nectria* and *Stilbum* are most prominent on dead branches of lime trees.

Investigation of the frog-hopper pest and disease of sugar cane. Agric. News **18**(446) : 174–175, (447) : 190–191, (448) : 207, (449) : 222–223, 1919.
A description of the disease supposed to be caused by the frog-hopper (*Tomaspis saccharina*). This is doubted and the author believes that it is due to *Marasmius* and *Odontia.*

Red ring disease of coconuts. Agric. News **18**(460) : 398, 1919.
The disease is caused by nematodes.

The cacao canker fungus as a cause of coconut but rot. Agric. News (Barbados) **18**(461) : 414, 1919.
Discusses Reinking's work on *Phytophthora faberi* on coconuts in the Philippine Islands and Ashby's studies on *P. palmivora* on coconuts in the West Indies.

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Rosellinia pepo an Ascomycete injurious to cacao in Trinidad, West Indies. Rev. Sci. & Pract. Agric. **11**(7) : 923–925, 1920.

Eradication of mosaic disease in Trinidad. Bull. Dept. Agric. Trinidad & Tobago **19**(3) : 105–106, 1921.

Disease of crop plants in the Lesser Antilles. 325 p., 1923.

This book contains much data on diseases.

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Notes on the proclaimed diseases and pests. Bull. Dept. Agric. Trinidad & Tobago. **19**(4) : 175–181, 1922. A

A discussion of bud rot of coconut, *Gloeosporium limetticolum* and of semi-parasitic flowering plants.

Diseases of cacao in Trinidad. Soc. Paper 775. Proc. Agric. Soc. Trinidad & Tobago. **22**(5) : 483–493, 1922.

Popular discussion of die-back, *Diplodia* pod rot, algal disease, thread blight, *Rosellinia* root disease and black pod rot and canker (*Phytophthora faberi*).

Disposal of black pods and cacao husks. Empire Prod. and Export **85**, Sept. 1923. (Trop. Agric. (Ceylon) **61**(5) : 295–296, 1923.)

This is a recommendation for the control of *Phytophthora faberi.*

Coconut bud-rot in Trinidad. Rept. Imper. Bot. Conf. London, **1924** : 161–162, 1925.

A brief discussion.

Diseases of coffee. Proc. Soc. Trinidad & Tobago. **26**(7) : 339–342, 1926.

Discusses *Omphalia flavida, Cercospora coffeicola* and *Sclerotium coffeicolum.*

Nyhus, P. O.

The potato situation in Argentine. Amer. Potato Journ. **13**(7) : 185–189, 1936.

Drought, insects and diseases reduced considerably the potato crop in Argentine and Uruguay. Foreign supply was urgent. The most noticeable diseases were those of virus type.

Ogilvie, L[awrence]

Preliminary Report of the Plant Pathologist for the period September 27 to December 31, 1923. Rept. Board & Dept. of Agric. (Bermuda) **1923** : 28–34, 1924.

The possibility of the introduction into Bermuda of the diseases of the banana. Agric. Bull. (Bermuda) Dept. Agric. **3**(2) : 7–8, 1924.

The author believes that there is very little danger. *Musa cavendishii* the species most commonly grown in Bermuda is said to be immune.

Celery in Bermuda. Agric. Bull. Bermuda Dept. Agric. **3**(6): 1–7, 1924.

Includes notes on *Cercospora apii.*

Report of the Plant Pathologist for the year 1924. Rept. Board & Dept. of Agric. (Bermuda) **1924**: 32–43, 1924.

Reports a *Gloeosporium* dieback on *Persea gratissima, G. musarium* on banana, *Helminthosporium* on corn, *Colletotrichum gloeosporioides* on citrus, *Uncinula necator* and *Gloeosporium ampelophagum* on grape, *Sclerotinia libertianum* (*S. sclerotiorum*) on carrots, celery, *Vicia* sp., *Botrytis* on *Lilium harinissi*, *Fusarium malli* on *onions* and *Perono-plasmopara* (*Pseudoperonospora cubensis*) on cucurbits.

Notes on leaf-roll of potatoes. Agric. Bull. Bermuda Dept. Agric. 3(12): 1, 1925.

Agenda put forward by Bermuda delegate. Proc. Ninth West Indian Agric. Conf. **1924**: 128–133, 1925.

Inspection and certification.

Report of the Plant Pathologist for the year 1925. Rpt. Dept. Agric. (Bermuda) **1925**: 36–63, 1926.

Reports several common diseases.

Notes on lilies. Agric. Bull. (Bermuda) Dept. Agric. **6**(4). 4–5, 1927.

A report of inspection of *Lilium longiflorum* var. *eximium* for mosaic.

The black tip disease of bananas. Agric. Bull. Dept. Agric. (Bermuda) **6**(9): 4–5, 1927.

A brief discussion of this disease which is attributed to *Cercospora musarum* Ashby. Causes a black discoloration beginning at the tip of the fruit. Attacks *Musa cavendishii.*

Aster yellows in Bermuda. A disease of many cultivated plants. Bermuda Agric. Bull. **6**(5): 7–8, 1927.

An important virus of *Lilium longiflorum* and its varieties. Nature **119**(2997): 528, 1927.

A report of yellow flat on *Lilium longiflorum* and its varieties, *L. giganteum* (*L. longiflorum* var. *tapesina*), *L. formosum* (*L. longi-florum* var. *insulare*) and *L. hamsii* (*L. longiflorum* var. *eximium*). Transmitted by *Aphis lilii.*

Notes on the growing of Citrus in (Bermuda) Agric. Bull. Bermuda. Dept. of Agric. **6**(11) : 3–5, (12) : 4–5, 1927. **7**(2) : 3–6, 1928.

Refers to *Colletotrichum gloeosporioides, Sporotrichum citri* and false melanose or greasy spot.

Late spraying of celery.—Agric. Bull. Dept. Agric. (Bermuda) **7**(5) : 4, 1928.

The author used Burgundy mixture for the control of *Septoria apii.*

''Black tip'', a finger-tip disease of the Chinese banana in Bermuda. Phytopathology **18**(6) : 531–538, 1928.

This disease is due to *Cercospora musarum.*

Report of the Plant Pathologist for the year 1927. Bermuda Dept. Agric. Ann. Rpt. **1927** : 26–37, 1928.

Notes on mosaic diseases of banana. *Hippeastrum* and lettuce and other diseases of crop plants.

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A mosaic disease of the Eastern lily. Phytopathology **19**(3) : 311–315, 1929.

A description and studies on insect transmission.

The Bermuda Easter Lily. Roy. Bot. Soc. (London) **39** : 4–6, 1929.

This paper is based on a study of a disease of *Lilium longiflorum* in Bermuda.

Olive, Edgar W[iliam]

Report of a trip to study and collect rust and other parasitic fungi of Puerto Rico. Brooklyn Bot. Gard. Rec. **5** : 117–122, 1916.

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Endophyllum-like rusts of Puerto Rico. Amer. Journ. Bot. **4**(1) : 44–52, 1917.

The cytological structure of *Botryorhiza Hippocrateae.* Brooklyn Bot. Garden Mem. **1** : 337–341, 1918.

Oliver y Lugo F[ernando]

El mosaico del tabaco y como combatirlo. (Tobacco mosaic and how to control it.) Rev. Agric. Puerto Rico. **10(1) : 11–14**, 1923.

The author believes that the disease persists in the soil and recommends a three-year crop rotation.

Otero Braquertt, José

Unas palabras sobre la enfermedad de la caña "El Matizado" o "rayas amarillas". (A few words about the sugar-cane disease mottling or "yellow stripes" in the Antilles.) Rev. Agr. Com. Trab. Cuba. 7(4). 46–54, 1924.

Otero, José I[dilio,] & Cook, Melville T[hurston]

Partial bibliography of virus diseases of plants. Journ. Agric. Univ. Puerto Rico 18(1–2) : 1–410, 1934.

This work contains numerous citations on plant pathology and mycological work of the area to cover.

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First supplement to partial bibliography of virus diseases of plants. Journ. Agric. Univ. Puerto Rico. 19(2) : 129–313, 1935.

First supplement to the above-mentioned work.

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Second supplement to partial bibliography of virus diseases of plants. Journ. Agric. Univ. Puerto Rico 20(3) : 741–818, 1936.

The title implies the character of work.

Pachano, Abelardo

Dos enfermedades de las papas. (Two diseases of potatoes.) Quinta Normal (Ambato, Ecuador) Estac. Exp. Circ. 7, 11 p., 1918.

A discussion of symptoms and control of *Phytophthora infestans* and *Alternaria solani.*

Paige, R. L.

The future of Uba cane in Puerto Rico. Memoire Ass'n Sugar Cane Tech., Puerto Rico. 1(1) : 25–27, 1922. (Facts About Sugar. 15(21) : 420–421, 1922.)

A brief reference to varietal resistance and susceptibility.

La enfermedad del matizado; su extirpación y control. (The mottling disease; its eradication and control.) Rev. Agric. Puerto Rico. 11(1) : 19–22, 1923. (Australian Sugar Journ.) 15(7) : 428–429, 1923. Facts About Sugar 17(1) : 14–15, 1923.)

Fields have been practically freed from mosaic by roguing.

Palm, B[jorn] T[owald]

A note on *Entyloma Dahliae* Syd. From Sumatra and Guatemala. Phytopathology 22(7) : 868–869, 1932.

On *Cyttaria* Berk. and *Cyttariella* n. gen. Ann. Mycol. 30 : 405–420, 1932.

Biolgoical notes on *Albugo*. Ann. Mycol. **30**: 426, 1932.

Rhodochytrium en Amerique centrale. Rev. Algol. **6**: 351–353, 1932.

Pflanzenkrankheiten aus Guatemala. (Plant diseases in Guatemala.) Zertschr. fur Pflanzenkrankh. u Pflanzenchutz. **42** (1) : 11–17, 1932.

An annotated list of plant diseases observed by the author during his stay in Guatemala with exception of virus diseases.

Algae as additional hosts of pathogens to angiosperms (Preliminary note) Zentralbl. Bakt. II. Abt. **87**(9–12) : 229–233, 1932.

Demonstrations that *Rosellinia necatrix* and *Pythium mamillatum* attack several algae (*Vaucheria, Hydrodictyon, Cladophora*) in the soil, *Giberella saubinetii* (*Fusarium* stage) and *Cylindrocarpon mali.* Also attack algae.

Eriodendron as host of *Bacterium malvacearum.* Phytopathology **22**(10) : 867–868, 1932.

This organism attacks a Mexican variety (pochote) of the kapok tree (*E. anfractuosum*).

Parodi E[dmundo]

Sulle cause della decadenza della cultura del cacao all' Ecuador e possibili remedi. (On the cause of the decline of cacao cultivation in Ecuador and possible remedies.) Agron. Colon. **30**(4) : 121–127, 1936. (Rev. Path. Veg. **26**: 176, 1936.)

The decline of the cacao industry in Ecuador is due mainly to witches' broom disease (*Marasmius perniciosus*) and moniliasis (*Monilia Roreri*). Control measures are given.

Parodia, Lorenzo R.

Las malezas de los cultivos en el partido de Pergamino. Buenos Aires p. 75–171, 1926.

Patouillard, Narcisse, & Lagerheim, G. de

Champignons de l' equateur. (Fungi of Ecuador.) Bull. Soc. Mycol. France **4**: 101–106, 1888.

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Champignous du Vénézuéla et, Principalement de la region du Haute-Orinoque, recoltés en 1887 par. M. A. Gaillard. (Fungi of Venezuela and especially those of Upper Orinoco region collected in 1887 by Mr. A. Gaillard.) Soc. Mycol. France **4**: 101–106; **6**: 7–46; 92–129, 1888.

Taxonomic, includes 278 species.

Quelques espéces nouvelles de champignons extraemopéens. Rev. Mycol. **13**: 135–158, 1891.

Taxonomic; records *Polyporus savoyamus, P. multiceps* and *P. turbinatus* as new species from Venezuela.

Contribution a l'etude des champinons extra-européens. Bull. Soc. Myc. France **3**: 119–131, 1887.

Taxonomic records *Phyllachora sphaerospora* Pat. as new species from Venezuela.

Liste de Champignons récoltés en Basse-Californie par M. Diguet. (List of fungi collected in Lower California by Mr. Diguet.) Journ. de Bot. **10**: 250–252, 1896.

Quelques champignos noveaux récoltés au Mexique par Paul Mauri. (Some new fungi collected in México by Paul Mauri.) Bull. Soc. Mycol. France **14**: 53–57, 1898.

Champignons nouveaux ou peu commus. (New or little known fungi.) Bull. Soc. Mycol. France **14**: 149–156, 1898.

Descriptions de quelques champignons extra-européens. Bull. Soc. Mycol. France **18**: 299–304, 1902.

Basidomycetes nouveaux du Brésil recucilles par F. Noack. (New Basidomycetes from Brazil collected by F. Noack.) Ann. Mycol. **5**: 364–366, 1907.

The root rot of coffee in Guadeloupe. Journ. Agr. Trop. **10** (104): 58–59, 1910.

Brief notes describing a coffee root disease caused by a fungus which probably is a *Rosellinia* or a *Dematophora*. Methods of control are given.

Quélques champignons du Costa Rica. (Some fungi from Costa Rica.) Bull. Soc. Mycol. France **28**: 140–143, 1912.

Quelques champignons de Vénézuela (Some fungi from Venezuela.) Bull. Soc. Mycol France **42**: 289–294, 1927.

Taxonomic, records.

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Champignons recueillis, par M. Myeul Grisol dans le Haut-Orenoque. (Fungi collected by M. Myeul Grisol in the Upper Orinoco.) Ann. du Cryptog. Exotique **1**: 266–278, 1928.

Taxonomic; records *Laschia lactea, Lentinus microloma* and *Crinipellis rubidus* as new species from Venezuela.

Pazschke, F. O.
Rabenhorst-Winter. Fungi Europaei Cent. 38, Cura Dr. O. Pazenschke. Hedwigia **30**: 197–209, 1891.

Erstes verzeichniss der E. Ule in den Jahren 1883–1887 in Brasilien gesammelten pilze. Hedwigia **31**: 93–114, 1892.

Zweites verzeichniss brasilianischer von E. Ule gesammelter pilze. Nach Untersuchungen von G. Bresadola, P. Hennings, H. Rehm und Nach eigénen beobachtungen zusammengeatellt von O. Pazschke. Hedwigia **55**: 50–55, 1896.

Pennington, N. S.
Uredineas recolectadas en las islas del delta del Paraná. (*Uredineaceae* collected in the delta of the Paraná.) Anal. Soc. Cient. Argentina **53**: 263–270, 1902; **55**: 31–40, 1903.

Pestico, J. F.
("Fucha" of the cotton plant in the department of Boyaca, Rep. Colombia.) Rev. Agric. **4**: 113–116, 1918.

A description of the disease which is said to be due to lack of good cultural practice.

Petrak, F., & Ciferri, R[afael]
Fungi Dominicani. Ann. Mycol. **28**: 377–420, 1930.

Mykologische Notizen VI, VIII, IX, XI. (Mycological Notes VI, VIII, IX, XI) Ann. Mycol. **22**: 1–182, 1924; **23**: 69, 1925; **25**: 258, 1927; **29**: 339–397, 1931.

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Fungi dominicani II. Ann. Mycol. **30**: 149–353, 1932.

Philippi, Federico
Der pilze: Chiles, soweit dieselben als nahrungesmittel gebrancht werden. Hedwigia **32**: 115–118, 1893.

Picado T., C[lodomiro]
Sur l'action á distance des champignons phytopathogenes. (Action at a distance by pathogenic fungi.) Congres Path. Veg. Strasbourg. p. 28–34, 1923.

Fusariose des cafeirs á Costa Rica. (Fusariosis of coffee in Costa Rica.) Rev. Path. Veg. Ent. Agr. **18**(10): 312–318, 1931.

Fusarium disease of coffee in Costa Rica. Jour. Dept. Agric. Puerto Rico. **16**(4): 389–400, 1932.

Discussion on *Fusarium anisophilum* and the disease caused by this fungus in the coffee trees of Costa Rica. He also discusses transmission on other host plants.

Colletotrichum des cafeiers et lesions radiculaires. (Coffee *Colletotrichum* and root lesions.) Rev. Path. Veg. & Ent. Agr. **20**(8): 268–270, 1933.

A coffee disease has been described recently from Costa Rica and two organisms were identified, *Glomerella cingulata* and *Fusarium literitium* var. *majus*. Gives experimental evidence to demonstrate that the direct cause of the root disease is the *Fusarium* and that the *Colletotrichum* is a parasite of the primary fungus.

Pickel, B.

Alguna parasitos radicolas do cafieiro em Pernambuco. (Some coffee root parasites in Pernambuco.) Characas e Quintaes, S. Paulo, **37**: 369–370, 1928.

Pittier, H[enri]

La enfermedad del banano y su causa. La Hacienda **7**(11): 343–346, 1912.

Estudio sobre deformaciones, enfermedades y enemigos del árbol de café en Venezuela. (Studies on deformation, diseases and enemies of the coffee tree in Venezuela.) Cam. Com. de Caracas, Bol. **120**, 1923.

Degeneration of cacao through natural hybridization. Journ. Hered. **26**: 385–390, 1935.

Plank, H. K.

Fungi attacking *Diatraea sacharalis* Fab. in Cuba. Jour. Econ. Ent. **22**: 983–984, 1929.

Plantengen, Marís H. J.

Pathologische verandenrigen in het phoem. (Pathological disturbances in the phloem.) Tésis. Utrecht. (Holland-Drukkery, Bearn.) 108 p., 1932.

In this rather extensive work the author reports his experimental studies in the transmission and inoculations in regard to the phloem necrosis disease of coffee in Surinam.

Plaxton, Dr.

Journ. of the Institute of Jamaica. **1**: 43–44, 1891–93, 1893.

Pino, Raphael del

El País Jan. 29, 1886. Reprinted from Balmaseda's paper in Tesoro del Agricultor Cubano. 2 ed. **2**: 135, 1893.

Poumd, F. J.

Studies of fruitfulnes in cacao. Rep. Cacao Res. (Trinidad) **1935**: 16–19, 1936.

Report on the effect of potash and phosphate on cacao infested with *Phytophthora palmivora.*

Prescott, S. C.

Diseases of the banana. United Fruit Co. (Boston, Mass.) Bull. 2, 1917.

Priode, C. N.

Observaciones adicionales sobre la enfermedad Pokkah-bong de la caña de azúcar en Cuba (Pokkah-bong disease of sugar cane in Cuba.) Memoria Cong Ann. Asoc. Tech. Azucareros (Cuba). **3**: 106–114, (Spanish): 98–106 (English), 1929.

A description of the symptoms of this disease which is caused by *Fusarium* sp.

Pokkah-bong and twisted top disease of cane. Facts About Sugar. **23**(52): 1244, 1928.

Popular.

Pokkah-bong and twisted top disease of sugar cane in Cuba. Phytopathology **19**(4): 343–366, 1929. (Reprinted as a Tropical Plant Research Scientic. Con. **14**, 25 p., 1929.)

A full account of the disease which is due to *Fusarium moniliforme* (*Giberella moniliformis*).

Target blotch of sugar cane. A new *Helminthosporium* disease. Facts About Sugar **24**(16): 376, 1929.

Popular.

Target blotch of sugar cane. Phytopathology **21**(1): 41–58, 1931.

A description of a disease which he attributes to *Helminthosporium* sp.

Notes on the diseases attacking the P.O.J. canes in Cuba. Proc. Ann. Conf. Asoc. Tech. Azuca. (Cuba) **5**: 138–144, 1931.

A discussion of eye spot (*Helminthosporium ocellum*), brown stripe (*H. stenospilum*), pokkah-bong (*Fusarium moniliforme*), red stripe (*Phytomonas rubrilineans*), root diseases and galls.

Cuban streak. Phytopathology **23**(8): 674–676, 1933.

A virus disease of sugar cane. Different from the streak in Africa.

Two hosts of the pokkah-bong disease other than sugar cane. Phytopathology **23**(8): 674–676, 1933.

This disease which has been attributed to *Fusarium moniliforme* attacks corn and sorghum in Cuba.

Puttemans, A[rsene]

Sur l'Oidium du Chéne au Brésil. (On the Oidium of Oak in Brazil.) Bull. Soc. Path. Vég. **7**:37–40, 1920.

O "mosaico" da cana de assucar. (The mosaic of sugar cane.) Bol. Min. Agric. Ind. o Com. Brazil. **12**(2): 350–355, 1926. (Rev. Appl. Ent. ser. A. **15**: 67, 1927.)

Uma ferrugem nova en a planta australiana cultivada no Brasil. (*Puccinia camargoi*) Bull. Mus. Nac. Río de Janeiro, **6**: 312–314, 1930.

Pyke, E. E.

Mycorrhiza in cacao. Rep. Cacao Res., Trinidad **1934**: 41–48, 1935.

Report of the occurrence of *Mycorrhiza* in Trinidad. Describes the forms and lesions.

Rada, G. G.

Tres enfermedades del manzano. (Three diseases of the apple.) Esta. Expt. Agric. La Molina (Perú) Circ. **25**, 21 p., 1934.

Popular notes giving the symptoms, etiology and control of apple scab (*Venturia inaequalis*), powdery mildew (*Podosphaera leucotricha*), and black rot (*Physalospora cydoniae* or *P. malorum*.)

Principales enfermedades del algodonero en el Perú. (The principal cotton diseases in Perú.) Est. Expt. Agric. (Perú) Circ. **28**, 19 p., 1935.

Popular notes of the most common diseases of cotton in Perú among which are mentioned *Fusarium vasinfectum*, *Rhizoctonia (Corticium) solani*, *Erysiphe malachrae*, *Helminthosporium gossypii*, *Alternaria tenuis*. Notes of control and species resistance are given.

Rahm, G.

Nematodes parasitas e semi-parasitas de diversas plantas culturaes do Brazil. Arch. Inst. Biol. **2**: 67–136, 1929.

Ramírez, Román

Manifestación rara en una cebolla. (A rare affection of an onion.) Rev. Agric. (México) **2**(1): 34, 1918.

A record of a disease without giving the cause.

Enfermedades del camote. (Diseases of the sweet potato.) Rev. Agric. (México) **2**(8): 344, 1918.

The disease appeared in Lower California and is attributed to *Oozonium omniovorum*.

Enfermedad grave de la caña. (Serious disease of cane.) Rev. Agric. (México) **4**(7–8): 348–349, 1919.

Reports *Thielaviopsis paradoxa* as cause of losses in yellow Caledonia in Mexico.

Dos parásito de la remolacha. (Two beet parasites.) Rev. Agric (México) **5**(2): 141–142, 1919.

One is due to *Septoria* sp.

Enfermedad de los árboles de limón. (A lemon disease.) (México) **5**:(3–4): 278–279, 1919.

A leaf spot caused by *Cladosporium* sp. *Macrosporium* sp.

Viruela del algodón. (Cotton rust.) Rev. Agric. (México) **5** (6): 461, 1920.

This disease which is due to *Aecidium gossypii* is the cause of heavy losses.

Enfermedad en los naranjos de Turicato, Michoacan. (An orange disease in Turicato, Michoacan.) Rev. Agric. (Mexico) **5**(7): 547, 1920.

An orange rot caused by *Penicillium* sp. and *Aspergillus* sp. and other fungi following insect punctures.

Enfermedad de los pinos de Guadalajara. (A pine disease in Guadalajara.) Rev. Agric. (México) **5**(9): 601, 1920.

A disease of the twigs caused by *Schizotrichum* sp.

Cyathus de la vid. (A *Cyathus* on grape.) Rev. Agric. (México) **5**(10): 720, 1921.

El chahuixtle rojo del frijol. (Rust of the bean.) Rev. Agric. (México) **5**(12): 830, 1921.

An account of *Uromyces appendiculatus* on the common bean.

Enfermedad de las dahlias. (A dahlia disease.) Rev. Agric. (México) **6**(2): 100, 1921.

Popular account of *Oidium* disease of dahlia.

Rands, R[obert] D[elafield]

South American leaf disease of Para rubber. U. S. Dept. Agric. Bull. **1286**, 18 p., 1924.

The results of the authors' studies on this disease of *Hevea brasiliensis*. The disease is caused by *Dothidella (Melanopsammopsis) ulei*.

Rangel, E[ugenio] dos Santos

Fungos parasitos do guado *Cajanus indicus* Spreng. (Parasitic fungi of pigeon pea *Cajanas indicus* Spreg.) A Lavoura **18**: 5–12, 1916.

Contribuicao para e estudio dos *Puccinias* das *Mytaceas*. (Contribution to the study of the *Puccinias* of the *Myrtaceae.*) Archiv. Mus. Nac. Río de Janeiro **18**: 147–156, 1916.

Fungos do Brasil novos ou mal conhecidos. (Fungi from Brazil new or little known.) Arch. Mus. Nac. Río de Janeiro **18**: 157–164, 1916.

O combate ao mosaico (Mosaic-disease control.) Bol. Agric. Bahia **1926**: 26–34, 1926.

O combate ao mosaico. (Mosaic-disease control.) A Lavoura **30**: 203–204, 1926.

Alguns fungos novos do Brasil. (Some new fungi from Brazil.) Arch. Jardin Bot. Río de Janeiro **2**: 67–71, 1918.

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Os inimigos vegetaes do cafeiro. (Coffee vegetable enemies.) Rev. Agr. Sec. Agr. Ind. Com. e Obras Pub. Bahía, **1**(12): 125–129, 1927.

Discusses the following fungi and describes the damages caused by each: *Hemileia vastatrix*, B. & Br. *Omphalia flavida* Man. & Ren., *Colletotrichum coffeanum* Noak, *Cercospora coffeicola* Br. & Curt. *Capnodium brasiliense* Putt., *Cephaleuros virescens* Kunze, *Corticium javanicum* Zimm., *Sphaerela coffeicola* Cooke.

Raunkiaer, C.

Fungi from the Danish West. Indies collected 1905–1906. Bot. Tidssk **29**(1): 1–25, 1908.

Myxomycetes from the West Indian Islands, St. Croix, St. Thomas and St. Jean. Dansk. Bot. Archiv. **5**(16): 1–9, 1928.

Reddick, Donald

Some diseases of wild potatoes in México. Phytopathology **22**(1): 609–612, 1932.

Some diseases of wild potatoes in México. Phytopathology (Abstract) **22**(1): 22, 1932.

Reported *Phytophthora infestans* on *Solanum verrucosum* and *Puccinia pittieriana* on *S. demissum.*

Rehm, H.

Exotische Ascomyceten. Hedwigia **28**: 295–303, 1889.

Taxonomic; includes *Corallomyces elegans* Berk. & Curt., from Venezuela.

Beträge zur Pilzflora von Südamerika III. Dothideaceae. (Contribution to the fungi flora of South America III. Dothideales Hedwigia **36**: 366–380, 1897.

Beiträge zur Pilzflora von Sudadmerika. (Contribution to the fungi flora of South América.) Hedwigia **37**: 321–328, 1898.

Beiträge zur Piezflora von Südamerika XII–XVII. Sphaeriales et al. (Contribution to the fungi flora of South America XII–XVII. Sphaeriales and others.) Hedwigia **40**: 100–124, 141–144, 145–170, 1901.

Beiträge zur Pilzflora von Südamerika. XIV. (Contribution to the fungi flora of South America.) Hedwigia **44**: 1–13, 1904.

————————, & **Rick, Johann.**
Noviatates brazilianses. Broteria **5**: 223–228, 1906.

Reinking, Otto A[ugust]
Banana freckle and leaf spot. Mycologia **18**(4) : 185–186, 1926.

Description of a disease of plantain (*Musa paradisiaca*) caused by the fungus *Macrophoma musae.*

Fusaria inoculation experiments. Relationship of various species of Fusaria to wilt and Colorado disease of banana. Phytopathology **16**(6) : 371–392, 1926.

The results of extensive studies on *Fusarium cubense.*

————————, & **Wollenweber, H. W.**
Tropical Fusaria. Phil. Journ. Science. **32**(2) : 103–253, 1927.

Descriptions of species found in Honduras and Guatemala.

————————, & **Manns, M. M.**
Parasitic and other Fusaria in tropical soils. Zeitschr. für Parasitenkunde. **6**(1) : 23–75, 1933.

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Parasitic and other Fusaria counted in Colombia soils. Zentralbl. für Bakt., Ab. 2, **89**(25–26) : 502–509, 1934.

Interesting new Fusaria. Zentralbl. für Bakt., Ab. 2, **89**(25–26) : 509–514, 1934.

Descriptions of four new species of *Fusaria* on cacao in Central America. They are *F. tumidum* var. *humi, F. sublimatum, F. elongatum* and *F. concolor.*

Parasitic and other Fusaria counted in Costa Rica and Panamá soils. Zentralbl. Bakt. II Abt. **90**: 4–16, 1934.

Soils and *Fusarium* diseases. Zbl. Bakt. Abt. II, **91**(11–15): 243–255, 1935.

The author states that various diseases caused by species of *Fusarium* appear to be correlated with soil conditions. Panama disease for instance, was found in Panama, Honduras and Costa Rica to be more severe on sandy than on clay soils. This fact is very important in control measures.

Cylindrocarpon fungus studies. Zbl. Bakt. Abt. II, **94**(5–8): 134–136, 1936.

Latin diagnoses are given of two new varieties of *Cylindrocarpon* (*C. janthothele* Wr. var. *minus* and *C. olidium* Wr. var. *suaveolens*, the perfect stage of the former being *Nectria mammoidea* Phil. & Plowr. var. *minor*.) isolated from the soil of banana plantations in Honduras, Costa Rica, Panama and South America.

Cylindrocarpon isolation from tropical soils. Zbl. Bakt. Abt. II, **94**(5–8): 137–142, 1936.

Cylindrocarpon olidum var. *suaveolens*, *C. olidium*, *C. janthothele* var. *minus*, *C. curavatum* and *C. radicicola* were isolated from banana plantations soils in Honduras, Guatemala, Costa Rica, Panama and Colombia. The phytopathological significance of these species of *Cylindrocarpon* has not yet been investigated.

Renacco, R.

Sobre algunas enfermedades parasitarias de las plantas cultivadas. (On some parasitic diseases of cultivated plants.) An. Soc. Cienc. Argentina. **81**: 62–70, 1916.

Rhoads, Arthur S.

Clitocybe mushroom root rot. A new disease of banana. Phytopathology (Abstract) **22**(23): 1, 1922.

Richardson Kuntz, P[edro Alejandro]

Estudios comparativos de las cañas kavangire, Zuinga y Cayanna 10. Ins. Expt. Sta. Puerto Rico. Circ. **73**, 11 p., 1923.

Popular, comparative descriptions of these varieties and reference to its tolerance to sugar-cane mosaic.

La producción de nuevas variedades de caña y sus resultados experimentales. (Sugar-cane varieties production and its experimental results.) Ins. Expt. Sta. Puerto Rico. Bul. **38**, 67 p., 1931.

Popular information of data of experimental field tests of new varieties of sugar cane in regard to susceptibility and immunity to the mosaic disease.

El mosaico en las nuevas variedades de caña de azúcar, P. R. 803, P. R. 807, F. C. 916, y S. C. 12(4). Mosaic on the new

sugar-cane varieties, P. R. 803, P. R. 807, F. C. 916 and S. C. 12(4).) Ins. Expt. Sta. Circ. **96**, 10 p., 1932.

Field tests to try the above-mentioned varieties in regard to mosaic immunity. P.R. 803 and F.C. 916 are highly tolerant, P.R. 807 commercially immune and S.C. 12(4) used as check highly susceptible. Results given in tabular form.

Resistencia relativa al matizado de cañas producidas en el país comparadas con las importadas. (The relative resistance to mosaic of native grown and imported canes.) Ins. Expt. Sta. Puerto Rico. Circ. **101**, 23 p., 1932.

Full details are given of the author's comparative observations on the relative productivity and resistance to mosaic of the locally produced and imported sugar-cane varieties in Puerto Rico. He reports that the Puerto Rico seedlings P.R. 803 and 807 and F.C. 916 were superior both in regard to yields and resistance to mosaic. Among the foreign, P.O.J. 2878 proved superior to B.H. 10(12) and S.C. 12(4) in both respects.

Cane varieties in Puerto Rico. Facts About Sugar **27**(12) : 530–532, 1932.

The author emphatically states that mosaic is the only sugar-cane disease of real economic importance in Puerto Rico. He also assures that its control today, presents virtually no difficulty.

Rick, Johann

Fungos do Rio Grande do Sul (Brasil) (Fungi from Río Grande del Sur. Brazil.) Broteria **3**: 276–292, 1904.

Fungi austro-americani exs. fasc. I. Ann. Mycol. **2**: 406–410, 1904.

Ueber einige neue und Kritische Pilze Süd-Amerikas. Ann. Mycol. **2**: 242–247, 1904.

Fungi austro-americani exs. fasc. II. Ann. Mycol. **3**: 15–18, 1905.

Pilze aus Río Grande do Sul. Ann. Mycol. **3**: 235–248, 1905.

Fungi austro-americani exs. fasc. III & IV. Ann. Mycol. **4**: 309–312, 1906.

Pilze aus Río Grande do Sul. Broteria **5**: 5–53, 1906.

Fungi austro-americani exs. Fasc. V & VI. Ann. Mycol. **5**: 28–31, 1907.

Fungi austro-americani exs. fasc. VII & VIII. Ann. Mycol. **5**: 335–338, 1907.

Fungi austro-americani exs. fasc. IX & X. Ann. Mycol. **6**: 105–108, 1908.

Protobasidiomycetes do Brazil. Rel Geral 3 d. Congr. Scient. Latino-Amer. Río Janeiro **3**(A): 405–412. 1909.

Fungi austro-americani exs. fasc. XI–XVIII. Ann. Mycol. **9**: 175–184, 1911.

Fungi gelatinosi et cartilaginosi. Rio Grandenses. Broteria **21**: 134–141, 1924.

Monographia pezizinearum riograndensium. Broteria, ser. Bot. **25**: 77–98, 98–122, 1931.

Monographia bolinearum riograndensium. Broteria ser. Bot. **25**: 72–76, 1931. (Broteria Cient. Nat. **1**: 35–46, 1932.)

Riddle, Lincoln W[are]

An enumeration of lichens collected by Clara Eaton Cummings in Jamaica I. Mycologia **4**(3): 125–140, 1912.

The lichens of Bermuda. Bull. Torrey Bot. Club. **43**: 145–160, 1916.

Some noteworthy lichens from Jamaica. Bull. Torrey Bot. Club. **44**: 321–330, 1917.

Lichens of St. Thomas. In Britton, N. L. The Flora of the American Virgin Island Brooklyn Bot. Gard. Mem. **I**: 109–115, 1918.

Lichens. In Britton, N. L. Flora of Bermuda. p. 470–479, 1918.

Lichens. In Britton, N. L. The Bahama Flora p. 522–553, 1920.

Ritchie, A. H. et al.

Woodpeckers and cacao. Journ. Jamaica Agric. Soc. **22**(2): 65–69, (3): 102–107, 1918.

Ritzema, Bos.*

Die Hexenbesen der kakao-baume in Suriname. Zeitschrift Pflanzen-krankheiten, Bd. **11**: 27, 1901.

* See also Bos.

Rogers, **John M., & Earle, F[ranklin] S[umner]**

A simple effective method of protecting citrus fruits against stem-end rot. Phytopathology **7**(5) : 361–367, 1917.

The method consist in shellacking the stem end, which is discussed in full. It is also recommended for other fruits as avocados, watermelons and many fruits to prevent stem end rot.

Roque, **Arturo**

Bacterial wilt of tobacco in Puerto Rico and its interstransmission to other solanaceous plants. Journ. Dept. Agric. Puerto Rico. **17**(2) : 145–156, 1933.

The disease is due to *Bacterium Solanacearum.*

Rorer, **J[ames] B[irch]**

Preliminary report on cacao spraying experiments. Bull. Dept. Agric. Trinidad **9**(64) : 10–14, 1910.

A bacterial disease of bananas and plantains. Soc. Peper 412. Proc. Agric. Soc. Trinidad **10**(4) : 109–113, 1910.

Popular. Cause of disease not given. Refers to F. S. Earle's Report of a trip to Jamaica which was published in Journ. New York Bot. Garden 4(37) : 8, 1903. Reprinted in West Indian Bull. 4(1) : 6, 1904.

The bud-rot of the coconut palm. Dept. Agric. Trinidad Bull. **9**(64) : 22–24, 1910.

Popular.

The witch broom disease of cacao in Surinam. Dept. Agric. (Trinidad) Bull. **9**(64) : 32–37, 1910.

A general discussion. *Colletotrichum luxificum* has been found on diseased material but the author states in a foot note that there is no proof that it is the causal organism.

The relationship of black rot of cacao pods to the canker of cacao trees. Dept. of Agric. (Trinidad) Bull. **9**(64) : 38, 1910. 1910.

The two diseases are due to *Phytophthora omnivora.*

Pod-rot, canker, and chupon-wilt of cacao caused by *Phytophthora* sp. Dept. Agric. Trinidad. Bull. **9**(65) : 79–103, 1910.

The author gives a history of the disease. Dr. de Verteuil in a book published in 1727 says: "In the year 1727 however, a terrible epidemic spread in the cacao plantations of Trinidad." He describes the disease and gives the results of studies.

When inoculations have been made with pure cultures of a number of these fungi the results have been uniformly negative so that *Nectria theobromae, N. bainii, Calonectria flavida,* two undetermined species of *Sphaerostilbe* frequently found on cankered cacao bark, and

Spicaria colorans cannot well be considered as the cause of cacao canker, or of the cacao pod disease.

A large number of inoculation experiments made by the writer with pure cultures of *Phytophthora omnivora* (?) proves conclusively that this fungus is the cause of the common cacao-pod-rot and of the disease known as canker, and that the diseased pods serve as the chief source of infection of the tree.

Report of the Mycologist for the year ending April 30, 1910. Bull. Dept. Agric. Trinidad **9**(65): 154–159, 1910.

General statement of diseases of several plants. Mentions *Septocylindrium suscepectus* of coconut. *Gloeosporium mangiferae* P. Henn. on fruit of mangoes.

Diseases of bananas. Bull. Dept. Agric. Trinidad. **9**(65): 157, 1910.

A bacterial disease of banana and plantains. Proc. Agric. Soc. Trinidad and Tobago **10**: 109–113, 1910.

A bacterial disease of bananas and plantains. Phytopathology **1**(1): 45–49, 1911.

Report of Mycologist. Trinidad Royal Gaz. **80**: 430, 1911.

Annual report of the Mycologist. Trinidad Bd. Agric. Ann. Rpt. **1910**: 8, 1911.

A preliminary list of Trinidad fungi. Board Agric. Trinidad & Tobago. Circ. 4, 1911.

Diseases of the coco-nut palm. Dept. Agric. Trinidad & Tobago. Circ. **4**: 27–33, 1911.

Bud-rot of the coconut palm. Dept. Agric. Trinidad & Tobago. Bull. **11**(70): 68–69, 1912.

Popular.

Some fruit diseases. Dept. Agric. Trinidad & Tobago, Bull. **11**(70): 75–76, 1912.

Popular, refers to *Gloeosporium mangifera* on mango and avocado.

Bud rot of the coco-nut palm. West Indian Bulletin **12**(4): 443–445, 1912.

A general discussion.

Spraying cacao. West Indian Bulletin. **12**(3): 275–277, 1912. (Dept. Agric. Trinidad & Tobago. Bull. **11**(70): 34–35, 1912.)

Results of spraying for *Phytophthora faberi*.

Some fruit diseases. West Indian Bulletin **12**(4): 464–465, 1912.

A brief reference to *Gloeosporium mangiferae* of the mango, and alligator pear, Panama and Moko (bacterial) diseases of bananas.

The Suriname witch-broom disease of cacao. Board Agric. Trinidad & Tobago, Circ. **10**, 13 p., 1913.

This paper includes the history of the disease, a description of symptoms, mycological studies, inoculation experiments and remedial measures.

The witch-broom disease in Surinam. Trinidad & Tobago Dept. Agric. Bull. **12**(72): 70–71, 1913.

A brief note.

Fungus diseases of casava. Bull. Dept. Agric. Trinidad & Tobago **14**(2): 36–38, 1915.

A popular paper in which the author says: "Leaf diseases attributed to different species of *Cercospora, C. manihotis, C. cassavae, C. henningsii* and to *Gloeosporium manihoti* have been reported from Brazil and adjacent parts of South America, Cuba, Florida and Tropical Africa, in fact from practically all countries where cassava is grown. The species of *Cercospora* cause leaf spots while *Gloeosporium manihoti* attacks chiefly the leaf stalk and causes the whole leaf to wilt."

The author also refers to two stem diseases caused by *Bacillus manihotus* and *Gloeosporium manihoti* in Brazil. Also to root disease in Jamaica.

The anthracnose of the mango. Bull. Dept. Agric. Trinidad & Tobago **14**(5): 164–171, 1915.

A popular description of the disease, infection experiments, spraying and shipping experiments.

A disease of immortal trees. Bull. Dept. Agric. Trinidad & Tobago **14**(4): 128–129, 1915.

Coconut bud rot. Bull. Dept. Agric. Trinidad & Tobago, **14** (4): 129–130, 1915.

A statement as to number of trees destroyed. Also that some organism other than *Bacillus coli* may be an important factor.

Citrus canker, Bull. of the Dept. Agric. Trinidad & Tobago. **14**(4): 130–131, 1915.

A popular description.

Fungous diseases of limes. Proc. Agric. Soc. Trinidad & Tobago, **15**(1) : 14–15, 1915.

A brief popular account in which the author mentions collar and root rots.

Pink disease of cacao. Bull. Dept. Agric. Trinidad & Tobago **15**(3) : 86–89, 1916.

Popular historical sketch, descrpition and control. Caused by *Corticium salmonicolor* B. et Br. which has been wrongly determined as *Corticium lilacino-fuscum.*

The Suriname witch-broom disease of cacao. Bull. Dept. Agric. Trinidad & Tobago **15**(1) : 5, 1916.

A brief popular statement, based on the author's Circular 10 Board of Agric. Trinidad & Tobago (July 30, 1913).

Cacao disease in Ecuador. Proc. Agric. Soc. Trinidad & Tobago. **16**(4) : 334–336, 1916.

A letter from Mr. Rorer.

Plant diseases and pests. The pink disease of cacao. Bull. Dept. Agric. Trinidad & Tobago **14**(1) : 1–4, 1915.

A preliminary list of Trinidad fungi. Report of the Mycologist for the year ending March 31, 1911. (Part II.) Board Agric. Trinidad & Tobago Circ. **4**: 37, 46, 1916.

The South American Hevea leaf disease. Bull. Dept. Agric. Trinidad & Tobago, **16**(3) : 128–129, 1917.

A brief report. Dr. Gerold Stahel of Suriname says that it is caused by a fungus, one stage of which is *Scolicotrichum.*

Cacao spraying experiments. Bull. Dept. Agric. Trinidad & Tobago, **16**(3) : 165–167, 1917.

Gives results and costs.

Algal disease of cacao. Proc. Agric. Soc. Trinidad & Tobago **17**(6) : 345–348, 1917.

Popular.

Enfermedades y plagas del cacao en el Ecuador, y métodos modernos apropiados al cultivo del cacao. (Diseases and pests of cacao in Ecuador and modern and appropiate methods of cacao culture.) Ambato, Ecuador, Assoc. Agric. Ecuador, 80 p., 1918.

The fungous diseases of roses and their treatment. Trinidad & Tobago Dept. Agric. Bull. **18**(1) : 29–31, 1919.

The author describes black spot (*Diplodia carpon rosae* Wall.) (*Actinonema rosae*), leaf spot (*Cercospora rosaeicola* Pass.), powdery mildew *Sphaerotheca panosa* Lev.), red rust (*Cephaleurus virescens* and rose canker (*Stilbum* sp.) and gives treatment.

The fungous diseases of avocados. Trinidad & Tobago Dept. Agric. Bull. **18**(3) : 132–133, 1919.

A description of the anthracnose disease and of a die-back of twigs that are infected with *Diplodia cacaoicola*.

The wither-tip of limes. Trinidad & Tobago Dept. Agric. Bull. **18**(9) : 1–3, 1919.

The disease is caused by *Gloeosporium limetticolum* Clausen. The author describes the symptoms and treatments.

Ecuador cacao succumbing to pests. Tea & Coffee Trade Journ. **49**(6) : 919–921, 1925.

Rosenfeld, A[rturo] H[inton]

Kavangerie: Puerto Rico's mosaic disease-resisting canes. Int. Sugar Journ. **22**(253) : 26–33, 1920.

Aspecto beneficioso del mosaico de la caña de azúcar. (Beneficial aspect of the sugar-cane mosaic disease.) Rev. Agric. Puerto Rico **12**(1) : 7–14, 1924. (Int. Sugar Journ. **26**(304) : 191–195, 1924.

La causa del matizado. Un paso hacia la solución de este misterio. (The cause of mosaic. One step toward the solution of this mystery.) Rev. de Agric. Puerto Rico **13**(3) : 145–148, 1924. (Int. Sugar Journ. **26**(310) : 535–536, Fact About Sugar **19**(18) : 425, Tropical Agric. (Ceylon) **64**(1) : 38–40, 1925.)

The Java P.O.J. Canes in Tucumán and Puerto Rico. Dept. Agric. Journ. Ins. Expt. Sta. **8**(3) : 1–44, 1925.

Selección de caña para la plantación. (Sugar cane selection for the planting.) Sugar **28**(3) : 153–155, 1926.

The sugar industry of Perú. Trop. Research Foundation Sci. Contribution **6**, 27 p., 1926. (Facts About Sugar **21**(3) : 50–52, 1926. Intern. Sugar Journal **28**(335) : 590–597, 1926.)

Lessons from the renaissance of a sugar industry. Int. Sugar Journ. **29**(348): 634–641, 1927. (Rev. Appl. Mycol. **7**: 400–401, 1927.

The author discusses the relationship of mosaic to varieties.

Rowlee, Silence

A collection of Costa Rican fungi. Mycologia **16**(3): 115–121, 1924.

Russell, T. A.

Report of the plant pathologist, 1933. Bermuda Dept. Agric. Ann. Rpt. **1933**: 28–36, 1934.

Scab spot or bacterial spotting of tomatoes. Bermuda Bd. Agric. Bull. **14**(9): 67–68, 1935.

Notes on a bacterial disease (*Bacterium vesicatorium*) that caused 50 per cent of losses of the tomatoes grown in Bermuda. Control attempts are given.

Plant pathological Report, 1935. Bermuda Bd. Agric. Rpt. **1935**: 18–23, 1936.

This report contains several items of phytopathological interest.

Diseases and pests of tomatoes in Bermuda. Trop. Agric. (Trinidad) **13**(3): 71–78, 1936.

A brief report in the following fungi and bacteria are recorded: *Fusarium lycopersici* var. *bulbigenum*, *Septoria lycopersici*, *Cladosporium fulvum*, *Sclerotinia sclerotiorum*, *Bacterium vesicatorium*, *Rhizoctonia (Corticium) solanii*, *Phoma destructiva*, *Phytophthora infestans*, and *Bacillus aroideae*.

Ryan, Ruth W[imfred]

The microthyriacea of Puerto Rico. Mycologia **16**(4): 177–196, 1924.

The development of the Perithecia in the Mycrothyriaceae and a comparison with *Meliola*. Mycologia **18**(3): 100–110, 1926

Saccardo, Pier Andrea, & Sydow, Hans.

[In] Saccardos' Sylloge Fungorum **16**: 625, 1902.

Notae mycologicae. Ann. Mycol. **3**: 165–171, 1905.

Mycomycetes americani novi Lecti a Cl. doctoribus C. E. Fairman et S. Bonansea. Journ. Mycol. **12**: 47–52, 1906.

Notae mycologicae, ser. XIV. Ann. Mycol. **10**: 310–322, 1912.

Noate mycologicae. Ann. Mycol. **11**: 14–21; 546–568, 1913; **12**: 282–314, 1914; **13**: 115–138, 1915.

Thirteen species from Uruguay.

Sáenz E., Roberto, & Chavarria A., Carlos

Enfermedades del cafeto. La chasparria (*Cercospora coffeicola*) (Coffee tree diseases. "La chasparria" (*Cercospora coffeicola*) Rev. Inst. Def. Café, Costa Rica **2**(9) : 193–202, 1935.

Popular account of a coffee disease caused by the fungus *Cercospora coffeicola.* Reviewed the work of Fawcett and Cook in Puerto Rico and Donald in Africa.

Sauri, F.

El mosaico de la caña de azúcar. (Sugar-cane mosaic.) Rev. Agric. Rept. Dominicana, **18**(6) : 101–104, 1923.

Popular.

Schelotto, Bartolomé

Algunas investigaciones sobre la "caries" del trigo. (Some investigations on wheat rust.) Bol. Chacra Expt. de La Previsión. Argentina **1**(4) : 40–47, 1933.

Experimental data in regard to behaviour of some wheat hybrid varieties.

Schilling, Fr.

Entwicklingsgeschichtliche und systematische untersuchung epiphyller Flechten. Hedwigia **67**(6) : 269–300, 1927.

Seaver, Fred J[ay]

The Hypocreales of North America—II. Mycologia **1**(5) : 177–207, 1909.

Hypocreales. North America. Flora. **3**: 1–88, 1910.

Hypocreales of North America—III. Mycologia **2**(2) : 48–93, 1910.

Some tropical cup-fungi. Mycologia **5**(4) : 185–193, 1913.

Illustrations and descriptions of cup-fungi II. *Sepultaria.* Mycologia **7**(4) : 197–199, 1915.

North American species of Ascodesmis. Mycologia **8**(1) : 1–4, 1916.

Photographs and descriptions of cup-fungi IV. *Peziza clypeata.* Mycologia **8**(5) : 235–238, 1916.

Bermuda fungi. Mem. New York Bot. Gard. **6**: 501–511, 1916.

Fungi; In Britton, N. L. Flora of Bermuda. p. 489–540, 1918.

Fungi; In Britton, N. L. The Bahama Flora p. 631–645, 1920.

Notes on North American Hypocreales. IV, *Aschersonia* and *Hypocrella*. Mycologia **12**(2): 93–97, 1920.

Studies in Tropical Ascomycetes—I. *Neopeckia diffusa* and *Herpotrichia albidostoma*. Mycologia **14**(5): 235–238, 1922.

Phyllostictaceae. North American Flora. **6**: 3–84, 1922.

Mycological work in Puerto Rico and the Virgin Islands. Journ. New York. Bot. Garden. **24**(281): 99–101, 1923.

Studies in Tropical Ascomycetes—II. An interesting *Zylaria* from Puerto Rico. Bull. Torrey Bot. Club. **50**: 307–310, 1923.

The fungous flora of St. Thomas. Mycologia **16**(1): 1–15, 1924.

Additions to the rust flora of the West Indies. Mycologia **16** (1): 46–48, 1924.

The fungus flora of St. Croix. Mycologia **17**(1): 1–17, 1925.

Studies in tropical Ascomycetes III. Puerto Rican cup-fungi. Mycologia **17**(1): 45–50, 1925.

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Botany of Puerto Rico and the Virgin Islands: Mycology, Sci. Survey of Puerto Rico and the Virgin Islands. New York Acad. Sci. **8**(1): 1–208, 1926.

Mycological work in Bermuda Island. Mycologia **18**(4): 137–138, 1926.

Mycological work in Bermuda. Journ. New York Bot. Gard. **27**(317): 90–93, 1926.

Studies in tropical Ascomycetes—IV. Some Hypocreales from Trinidad. Mycologia **20**(2): 52–59, 1928.

Studies in Tropical Ascomycetes—V. Species of *Phyllachora*. Mycologia **20**(4): 214–225, 1928.

The North American cup-fungi (Operculales) 284 p., New York, 1928.

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Botany of Puerto Rico and the Virgin Islands. Supplement to Mycology. Sci. Survey of Puerto Rico & the Virgin Islands. New York Acad. Sci. **8**(2): 209–311, 1932.

Seín, Jr., F[rancisco]
Sugar-cane mosaic and other grasses. Ins. Expt. Sta. **Report of** the Div. of Ent. Puerto Rico. **1923–24**: 114, 1924.

Report of experiments in progress in relation to mosaic transmission using different aphid species.

A new mechanical method for artificially transmitting sugar-cane mosaic Journ. Dept. Agric. Puerto Rico **14**(2): 49–68, **1930.**

The author describes a new method in which he uses very fine insect pins. The spindle of a diseased plant is removed and placed in close contact with the spindle of a healthy plant. The pins are pushed through the diseased and into the healthy plant. The author reports a high percentage of infection.

Artificial transmission and other studies on sugar-cane mosaic. Fourth Congress Intern. Soc. Sugar-Cane Technologists, Puerto Rico, 1932. Bull. **84,** 6 p., 1933.

The author discusses the subject under widely different points of view. Some of them towards the nature of the virus and others dealing with its mechanical and insect transmission *Aphis maidis* is conclusively a carrier of the disease.

Serrano, Luis A[ntonio]
Mosaico (Mosaic). Imp. Bolívar, Caracas, Venezuela **16** p., 1927.

Report of a trip of inspection made by the author to the northern sugar-cane region of Venezuela. It includes a brief review of the work of others and a short historical sketch. Gives symptoms and methods of control and prevention.

Sharples, A.
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De Hevea-bladziekte van Zuid-America. (The *Hevea* leaf disease in South America.) Meded. Dept. Land-bouw Suriname, No. **1**. 1915

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Marasmius perniciosus nov. sp. de verovzaker der Krullotenziekte van de cacao in Surinam. (*Marasmius perniciosus* n. sp. the cause of the "Krulloten" disease of cacao in Surinam.) Dept. Landb. Surinam Bull. **33**, 27 p., 1915. (Agric. News (Barbados) **14**(354): 382, 1915.)

A very complete description of the disease, the origin and the results of experimental studies.

Over de besrijding der Zuid-Amerikaansche Heavea-bladziekte. (Combating the South-American *Hevea*-leaf diseases.) Meded. Dept. Landbouw Suriname, No. **6**. 1916.

De Zuid-Amerikaansche Hevea-bladziekte veroszaakt door *Melanopsammopsis Ulei.* nov. gen. (—*Dothidella Ulei* P. Hennings). Dept. van den Landbouw in Suriname. Bull. **34**, 111 p., 1917.

De Zuid-Amerikaansche Hevea-bladziekte op de rubberplantage der "Lawa catontchoue Compagnie. (*Hevea* leaf-disease in Lawa.) West Indie **4**: 63–64, 1919.

The disease is due to *Melanopsammopsis ulei.*

De Zeefvatemziekte (phloëmnecrose) van de Liberiakoffie in Suriname. (Phloem necrosis of Liberian coffee in Suriname.) Meded. Dept. Landb. Suriname, Bull. **12**, 2 p., 1917.

The author proposes the name phloem-necrosis disease due to features resembling leaf roll of potato and sereh of sugar cane.

De *Sclerotium*-ziekte van de Liberia-koffie in Suriname. (The *Sclerotium* disease of Liberian coffee in Suriname.) Dept. van den Landb. Suriname Bull. **13**, 1918.

This disease has been discussed by Kuyper in relation to *Corenium* sp. It has been more important every day since its first appearance last year. It is briefly described in regard to its development in relation to climatic conditions.

Brijdrage tot de kennis der Krullotenziekte. (Contribution to our knowledges on witches' broom disease.) Dept. van de Landbouw, Bull. **39**, 1919.

Verslag 1918. Department Landbouw Suriname. (Report 1918, Dept. of Agric. of Suriname.) Suriname Dept. Landb. **1918**: 14–16, 1919.

Brief notes on crop diseases and their control.

De Zeefvatenziekte (phloëmnecrose) van den Liberica en Suriname. (Phoemnecrosis of Liberian coffee in Surinam.) Surinam Dept. Landb. Bull. **40**. 31 p., 1920.

Continuation of previous investigations. The author concludes that the disease presents an acute form of the root disease or a cronic form causing the death of the affected parts preceded by the falling of the older leaves. He notices a great similarity with leaf roll disease of the potato known as phloem necrosis.

De *Sclerotium*-ziekte van de Liberia koffie in Suriname, veroorzaakt door *Sclerotium coffeciolum* n. sp. (The *Sclerotium* diseases of Liberian coffee in Suriname caused by *Sclerotium coffeicolum.*) Dept. Landb. Suriname Bull. **42**, 34 p., 1921.

Report of field and laboratory studies of this disease. The fungus *Sclerotium coffeicolum* was isolated which is supposed to be the cause of the disease.

Verslag over het jaar, 1922.—Dept. van Landb. in Suriname. (Report of the Dept. of Agriculture, Suriname, for the year 1922) 106 p., 1923.

Pages 25–31 refer to diseases.

De krullotenziekte in Ecuador. (The witch broom disease in Ecuador.) West Indie **8**: 97–100, 1923.

The disease was discovered in Ecuador by Rorer in 1922. Many plantations have been abandoned. It attacks the "cacao blanco" (*Theobroma bicolor*) and "cacao del monte" (*T. balooensis*).

Der Kaffeekirschenkafer in Suriname. Tropenpflanzer **29**: 79, 1926.

The South American Hevea leaf disease in Suriname. India Rubber World. 76(5): 251–252, 1927.

Popular. The disease is caused *Melanopsammopsis ulei*.

Witch broom disease. Proc. Agric. Soc. Trinidad & Tobago. **29**(1): 12–18, 1929.

Popular. Attributes disease to *Marasmius perniciosus*.

———————, & **Bunzli, H.**

Nieuwe onderzoekingen over de zeefvatenziekte (phoëmnecrose) van den Koffi in Suriname. (New researches about phloemnecrosis of coffee in Suriname.) Indische Mercuur **53**(42): 919–921, 1930.

Phloem-necrosis attacks all species of coffee (*C. arabica, C. robusta*) in Surinam, and is the most serious disease. The living sieve tubes contains a *Phytomonas* sp. which is similar to *P. Davidi*, but smaller.

Zur kenntnis der siebrohrenkrankheit (Phloëmnecrosis) des kaffeenbaumes in Surinam. I. Mikrospische untersuchungen und infektionsversuche. (Contribution to the knowledge of the sieve-tube disease (phloem-necrosis) of the coffee tree in Surinam. I. Microscopic investigations and inoculation experiments.) Phytopath. Zeitschr. **4**(1): 65–82, 1931.

The most serious disease of Liberian coffee in Suriname. Not known in any other country. An organism has been found in the sieve tubes which is described as *Phytomonas leptovasorum*.

Zur kenntnis der siebrohrenkrankheit (Phloëmnekrose des kaffeebaumes in Surinam. II. (Contribution to the knowledge of the sieve-tube disease (phloem necrosis) of the coffee tree in Surinam. II.) Phytopath. Zeitschr., **4**(5): 539–544, 1932.

The author reports excessive necrosis in diseased plants. The red-disease of Brazil shows similar symptom. The disease was observed in Pernambuco and Parahyba in 1917.

Contribution to the knowledge of witch-broom disease. Trop. Agric. (Trinidad) **9**(6): 167–176, 1932.

A discussion of this disease which is attributed to *Marasmius perniciosus*. A translation of a paper which appeared in Bull. 39 of the Surinam Dept. Agric.

Verslag van en Directeur (Report of the Director.) Ex Verslag ak over de jaren 1931 en 1932. Dept. Landbouw proofstat. Suriname, p. 5–34, 1933.

Notes on several crop-plant diseases observed in Surinam.

Zur Kenntnis der Siebröhrenkrankheit des Kaffeebaumes in Suriname III. (On the study of the "Sieve tube disease" (Phloemnecrosis) of the coffee tree III.) Phytopath. Zeitschr. **6**(4): 335–357, 1933.

Description of the disease and detailed account of the work done up to the present on this obscure disease.

The banana leaf disease in Suriname. Trop. Agric. (Trinidad) **11**(6): 138–142, 1934.

Account of a leaf spot disease of bananas which was first noticed in 1933. The disease was first noticed on *Musa sapientum* variety Congo, but has spread to all varieties grown in Surinam including *M. textilis*. Two parasitic fungi has been isolated so far from the lesions *Helminthosporium torulosum* and *Scolectotrichum musae*.

De tagenwoordige stand van het onderzoek naar den overdragen der zeefvatenziekte van de koffie. (Actual state of the investigations on the carrier of phloem necrosis of coffee.) Landbouwproefstat. Suriname Meded. 7, 9 p., 1934.

Experimental evidence indicates that the insect *Lincus* sp. may be considered as the responsible for the transmission of the flagelato *Phytomonas leptovasorum* associated with the phloem necrosis disease of coffee. Detail of experiments.

De Krullotenziekte in Brazilië (The witches' broom disease in Brazil) Ind. Mercuur **58**(6): 71, 1935.

Brief notes on witches' broom of cacao in Surinam (*Marasmius perniciosus*).

Stahl, C[orwin] F[loyd]

A mosaic of corn. Proc. 2nd. Conf. Internat. Soc. Sugar-Cane Tech. **2**: 85–87, 1927.

The most common mosaic of corn in Cuba produces stripping. It is carried from corn to corn by *Peregrinus maidis*. The sugar-cane mosaic is carried from cane to corn by *Aphis maidis*.

Corn-stripe disease in Cuba not identical with sugar-cane mosaic. Trop. Plant. Res. Foundation Bull. **7**: 3–11, 1927. (Rev. Appl. Entomology Ser. A. **17**: 420, 1927; Rev. Appl. Mycol. **7**: 158–160, 1927.)

This paper gives proof that the corn-stripe disease of Cuba which is similar to sugar-cane mosaic is different. The disease is transmitted by a leafhopper (*Peregrinus maidis*, Ashm.) And apparently not transmitted by *Aphis maidis*, Fitch.

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El comportamiento de las nuevas cañas P.O.J. en relación con la enfermedad del mosaico de la caña de azúcar en Cuba. (The behavior of the new P.O.J. cane toward mosaic.) Est. Exp. del Club Azucarero de Cuba, 13 p., 1929, (Trop. Plant Res. Foundation, Bull. **9**, 12 p., 1929.)

The authors discuss the comparative resistance of several varieties, the results of inoculation of several varieties by means of *Aphis maidis*. The paper closes with a discussion of resistance, immunity and tolerance.

Stakman, E. C., Hines, Lee., Cassell, Robert C., & Levine, M. N.

Population trends of physiologic forms of *Puccinia graminis tritici*, 1930 to 1934. Phytopathology (Abstract) **25**(1): 34, 1935.

Determinations of physiologic forms of *Pucinia graminis tritici* from United States and Mexico.

Starback, Karl

Ascomyceten der Schwedischen Chaco-Cordillera expedition. Ark-Bot. **57**: 1–35, 1905.

Steiner, G. & Heinly, Helen.

The possibility of control of *Heterodera radicola* and other plant-injurious nemas by means of predatory nemas, etc., Journ. Wash. Acad. Sci. **12**: 367–386, 1922.

A nematosis of yams caused by a new species of *Hoplolaimus*. U.S.D.A. Plant Dis. Rep. **15**(11): 121, 1931.

Stell, Frank

Notes on fungi, Journ. Bd. Agric. British Guiana **14**(1): 39–41, 1921.

A brief discussion of smut (*Ustilago maydis*) of corn and red rot (*Colletotrichum falcatum*) of sugar cane.

Some common diseases of kitchen garden crops. (Society paper 787.) Proc. Agric. Soc. Trinidad and Tobago, **22**(11): 779–785, 1922.

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A fungus disease of cabbages. Bull. Dept. Agric. Trinidad & Tobago **22**(2–4) : 116. 1922.

Reports *Fusarium conglutinans.*

Wither-tip of limes in Dominica. Proc. Agric. Soc. Trinidad & Tobago **24**(4–5) : 181–185, 1924.

A study of *Gloeosporium limetticolum.*

Plant sanitation. Proc. Agric. Soc. Trinidad & Tobago **27**(9) : 393–404, 1927.

A popular address on control of plant diseases.

Witch-broom disease of cacao and its control. Bull. Dept. Agric. Trinidad & Tobago **21**(1) : 3–14, 1928.

Plant pathology. Trinidad & Tobago Dept. Agric. Ann. Rpt. **1928** : 49–51, 1929.

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Witch-broom disease of cacao and its control. With an appendix: What is a fungus? by Stell. Bull. Dept. Agric. (Trinidad) **21**(3) : 3–19, 1928. (Brit. Guiana Agric. Journ. **2**(2) : 109–110, 1929.)

A popular discussion of the causal organism (*Marasmius perniciosus*) and methods of control.

Sugar-cane mosaic in Trinidad. Int. Sugar Journ. **21**(368) : 414, 415, 1929. (Rev. Appl. Mycol. **9**(2) : 131–132, 1930.)

A brief report.

Witch-broom diseases of cacao. Proc. Agric. Soc. Trinidad & Tobago **32**(1) : 23–31, 1932.

A review of the damages of this disease in Trinidad and efforts to control it.

Report of Mr. F. Stell, Mycologist, Department of Agriculture, on his visit to Ecuador to study witch-broom disease (*Marasmius perniciousus*) of cocoa. Trinidad and Tobago Council Paper No. **137**, 12 p., 1933.

Report of Mycologist, 1933. Trinidad & Tobago Dept. Agric. Admin. Rpt. **1933** : 43–45, 1934.

In this report received special attention the cacao witches' broom caused by *Marasmius perniciosus*, banana wilt caused by *Fusarium cubense* and a *Helminthosporium* which caused a great deal of damages to this fodder grass *Pennissetum purpureum.*

Banana growing and associated diseases. Proc. Agric. Soc. Trinidad & Tobago **35**(9) : 357–368, 1934.

The author briefly discusses cultural points. Panama disease (*Fusarium (oxysporum) cubense*) and on "moko" disease (*Bacterium solanacearum*) and their control.

Report of the Mycologist, 1934. Trinidad & Tobago. Dept. Agric. Ann. Rpt. **1934**: 47–50, 1935.

Notes are given on the most prevalent and important diseases of economic crops thus: sugar cane mosaic; Banana Panama disease (*Fusarium oxysporum cubense;* Banana "moko" disease (*Bacterium solanacearum*). Cacao witches' broom (*Marasmius perniciosus*). Also cacao shade trees (*Erythrina velutura,* and *E. Umbrosa*) infections by a species of *Sphaerostilbe.*

Report of the Mycologist, 1935. Trinidad & Tobago Dept. Agric. Rpt. **1935**: 47–50, 1936.

This report includes notes on Cacao witches' broom disease (*Marasmius perniciosus*); Cacao black pod (*Phytophthora palmivora*); Banana Panama disease (*Fusarium oxysporum cubense*); Gros Michel Banana leaf spot (*Cercospora musae, Cordana* sp. (*Scolecotrichum Musae*); Tonga bean (*Dipteryx odorata*) thread blight (*Corticium Koleroga*).

Stevens, **F[rank] L[incoln]**

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The genus *Meliola* in Puerto Rico. Illinois Biol. Mon. **2**, 86 p., 1916.

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A parasite of the tree fern. (*Cyathea*). Bot. Gaz. **68**(3) : 222–225, 1919.

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Three new fungi from Puerto Rico. Mycologia **12**(1): 52–53, 1920.

The relation of plant pathology to human welfare. Amer. Journ. Bot. **8**(6): 315–322, 1921.

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A meliola disease of cacao. Phytopathology **13**(5): 247–250, 1923.

A description of a leaf disease in British Guiana. The fungus is *Meliola guianensis* n. sp. The spots were sometimes overgrown by *Helminthosporium guianensis* and *Nectria portoricensis.* Host not given.

Parasitic fungi from British Guiana and Trinidad. Illinois Univ. Biol. Monogr. **8**(3): 1–76, 1924.

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The *Hemisphaeriaceae* of British Guiana and Trinidad. Bot. Gaz. **79**(3): 265–296, 1925.

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Species of *Meliola* and *Irene* from British Guiana and Trinidad. Mycologia **18**(1): 1–22, 1926.

Fungi from Costa Rica and Panama. Univ. Illinois Biol. Mongr. **11**(2): 1–102, 1927.

New Tropical fungi. Mycologia **19**(5): 231–238, 1927.

The *Meliolinae* I, II. Ann. Mycol. 25: 405–469, 1927. **23**: 165–383, 1928.

Parasitic fungi Panama. Ann. Mycol. **27**: 281–286, 1930.

Parasitic fungi of British Guiana, Trinidad and Costa Rica. An. Mycol. **28**: 364–371, 1930.

Parasitic fungi of Perú and Ecuador An. Mycol. **29**: 102–106, 1931.

Tropical plant pathology and mycology. Bull. Torrey Bot. Club. **59**(1): 1–6, 1932.

Stevenson, G. C.
Foot-rot and root-rot disease of the pawpaw. Dissertation (unpublished) for the A. T. C. A., 1932.

This citation was found in Trop. Agric. 10(11): 329 but no data.

Report on the British West Indies Central Sugar Cane Breeding Station for the year ending September 30, 1934.

Report is given of observations on *Bacterium vascularum* on 20 different varieties of sugar cane in Barbados.

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Investigations into the root development of the sugar cane in Barbados. I. Root development in several varieties under one environment. Bull. Brit. West Indies Centr. Sugar-Cane Breed. Stat. **5**: 44, 1935.

Stevenson, J[ohn] A[lbert]
Pink disease of citrus. *Corticium salminicolor.* Puerto Rico Progress, April 10, p. 4, 1916.

An enemy of citrus fruits. *Microcera fujikuoi.* Puerto Rico Progress April 10; 4, 1916.

Report of the pathologist. Bd. Comm. Agric. Puerto Rico. Fourth Ann. **1916**: 33–34, 1916.

Enfermedad de la caña de azúcar en Puerto Rico. (Sugar-cane disease in Puerto Rico.) Mundo Azucarero **5**(1): 19–24, 1917. (Louisiana Planter **59**: 76–78, 1917.)

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Diseases of vegetable and garden crops. Puerto Rico Journ. Dept. Agric. **1**(2): 93–97, 1917.

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Report of the Pathologist. Puerto Rico, Board Comms. Agric. Ann. Rpt. 1917, **5**: 35–74, 1917.

An epiphytotic of cane disease in Puerto Rico. Phytopathology **7**(6): 418–425, 1917.

La nueva enfermedad de la caña. (The new sugar-cane disease.) Puerto Rico Ins. Expt. Sta. Circ. **11**, 12 p., **1917.** (Louisiana Planter & Sugar Manufac. **59**: 76–78, 1917; **Agric.** News Barbados, **16**: 286, 1917.)

A paper on the sugar-cane mosaic in Puerto Rico.

Report of the Pathologist for 1917. Ins. Expt. Sta. Puerto Rico. Ann. Rpt. **1916–17**: 37–77, 1917.

A report on the presence of sugar-cane mosaic in Puerto Rico.

La enfermedad nueva de la caña. (The new sugar-cane disease.) Rev. Agric. Puerto Rico. 1(1): 18–25, 1918.

A detailed popular account of sugar-cane mosaic. The author states that the disease appeared to be in the Island for several years previously; but very recently it has attracted attention and become a serious menace to the sugar industry in Puerto Rico. The author discusses the disease giving symptoms, susceptible varieties, means of transmission and control measures.

The green muscardine fungus in Puerto Rico. Journ. Dept. Agric. Puerto Rico **2**(1): 19–32, 1918.

Citrus diseases of Puerto Rico. Journ. Dept. Agric. Puerto Rico. **2**(2): 43–123, 1918.

Check list of Puerto Rican fungi and host index. Journ. Dept. Agric. Puerto Rico **2**(3): 125–264, 1918.

Notas sobre medios de combatir el matizado de la caña. (Notes on how to control sugar-cane mosaic.) Rev. Agric. Puerto Rico, **2**(2): 11–12, 1918.

Brief notes devising the means to fight mosaic of sugar cane.

La enfermedad del mosaico del tabaco. (Tobacco mosaic disease.) Rev. Agric. Puerto Rico. **2**(1): 39–44, 1918.

El matizado de la caña. (Sugar-cane mottling.) Rev. de **Agric.** Puerto Rico. **2**(1): 51–52, 1918.

Brief note stating that mosaic is due to virus and not to fertilizers or soil conditions.

Cuarentena de plantas. (Plants quarantine.) **Rev. Agric.** Puerto Rico **1**(4): 176–180, 1918.

Gives reasons for quarantine.

Cuarentena de plantas en Puerto Rico. (Plant quarentine in Puerto Rico.) Rev. Agric. Puerto Rico 1(4): 213–216, 1918.

A review of the quarantine law.

La enfermedad de las raíces de la caña. (The disease of sugar cane roots.) Rev. Agric. Puerto Rico. **1**(6): 269–279, 1918.

Refers to *Marasmius sacchari, Himantia stellifera, Odontia saccharicola.*

Marchitez y falta de desarrollo en las plantaciones de cacao de la República Dominicana. (Poor condition of cacao in Santo Domingo.) Rev. Agric. (Santo Domingo) **14**(9): 265–273, 1918.

Report of a trip to Santo Domingo.

Catálogo de las enfermedades fungosas y no-parasíticas que atacan las plantas económicas de Puerto Rico. (Catalog of the fungus and non-parasitic diseases attacking economic plants in Puerto Rico.) Rev. Agr. Puerto Rico. **2**(1): 19–27, 1918. **2**(2): 23–33, 1919.

The mottling or yellow-stripe disease of sugar cane. Journ. Dept. Agric. Puerto Rico. **3**(3): 3–76, 1919.

A very lengthy paper giving distribution on the Island, rate and manner of spread, varietal susceptibility, symptoms, field culture relations, possible causes and methods of transmission, plot experiments and methods of control.

Enfermedades del citro en Puerto Rico. (Citrus diseases in Puerto Rico.) Rev. Agr. Puerto Rico. **3**(6): 25–49, 1919. **4**(3): 34–46; (4): 25–36; (5): 22, 27; (6): 9–19, 1920.

Control of sugar-cane mottling disease. Sugar **23**: 92–95; 539–554, 1921.

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Foreign plant diseases. A manual of economic plant diseases which are new to or not widely distributed in the United States. U. S. D. A. Contribution from the Fed. Hort. Board 198 p., 1926.

The South American disease of Para rubber invades Central America. U.S.D.A. Plant Disease Reporter. **19**(20): 308, 1935.

The disease (*Dothidella ulei*, P. Henn.) has been reported previously from Perú, Brasil, Trinidad, Guianas, and Bolivia. It is now reported from Costa Rica.

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Expedition of the California Academy of Sciences to the Galapagos Islands 1905–06. VII Notes on the lichens of the Galapagos Islands. Proc. California Acad. Sci. **1**: 431–446, 1912.

Stockdale, F. A.

Fungus diseases of cacao and sanitation of cacao orchards. Imp. Dept. Agric. West Indies Pamphlet **54**, 47 p., 1906.

Coco-nut palm disease. Proc. of the Agric. Soc. of Trinidad **7**: 9–31, 1906.

Coco-nut palm disease. Proc. Agric. Soc. Trinidad & Tobago Trinidad and Tobago **7**: 45, 1906.

Coconut palm disease. Bull. Dept. Agric. Jamaica **5**(6–7): 111–139, 1907.

A discussion of a root disease, a leaf disease and a bud-rot disease which may be the same as has been referred to by other writers.

Fungus diseases of pine-apple. West Indian Bull. **8**(2): 158–166, 1907.

A discussion of tangle root, blight, black heart or core rot and storage disease.

Coconut palm disease. Trinidad Royal Gazette, p. 350, 361–362, Feb. 1907.

The principal fungus diseases of cacao. Soc. paper **324**, Proc. Agric. Soc. Trinidad & Tobago **8**: 279–287, 1908.

Popular discussion of stem canker (*Nectria calonectria*, etc.), die-back (*Diplodia cacaoicola*), pink disease (*Corticium lilaco-fuscum*), thread blights, root diseases, brown pod (*Diplodia cacaoicola*) and black pod (*Phytophthora palmivora*).

Root diseases of sugar cane. Soc. paper **333**. Proc. Agric. Soc. Trinidad & Tobago **8**: 377–386, 1908. (West Indian Bull. **9**(2): 103–116, 1908.)

Popular discussion of diseases attributed to *Marasmius sacchari* and related species.

Fungous diseases of cacao and sanitation of cacao orchards. West Indian Bulletin **9**(2): 166–189, 1908.

This paper includes a discussion of root diseases: canker (*Nectria ditissima*), *N. Bainii*, *N. theobromae* and *Calonectria flavida*, die-back (*Diplodia cacaoicola*), pink disease (*Corticium lilaco-fuscum*), thread blights (*Marasmius equicrinus*), brown pod (*Diplodia cacaoicola*), black rot (*Phytophthora omnivora*), scabby pod (*Lasiodiplodia* sp.)

Fungous diseases of coconuts in the West Indies. West Indian Bull. **9**(4): 361–371, 1909.
Popular.

Sturgis, William C[odman]
Myxomycetes from South America. Mycologia **8**(1): 34–41, 1916.

Sutherland, J. B.
Banana breeding, etc. Jamaica Journ. Agric. Soc. **36**(9): 463–465, 1932.
A lecture describing methods for the control of *Fusarium oxysporum cubense.*

Swingle, Walter T.
Danger of introducing a Central American coffee disease into Hawaii. U. S. D. A. Div. of Veg. Phys. & Path. Circ. **16**, 4 p., 1898.
In this paper the author warned the Hawaiian planters as to the danger of introducing into Hawaii from Brazil the following coffee pests: *Stilbella flavida, Sphaerella coffeicola, Hemileia vastatrix* and nematodes.

Sydow, Hans, & Sydow, Paul
Fungi aliquot novia F. Stuckert in Argentina lecti. Mem. Herb. Boisser, **4**: 1, 2, 1900.

Fungi novi brasiliensis a cl. Ule lecti. Bul. Herb. Boisser, ser. 2, **1**: 77–85, 1900.

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Beitrag zur Pilzflora Sud-Amerikas. (Contribution to the fungus flora of South America.) Hedwigia, Beiblat **42**: 105–106, 1903.

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Verseichnis der von Herrn. F. Noack in Brasilien gesammetten Pilze. Ann. Mycol. **5**: 348–363, 1907.

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Fungi paraënsis. Hedwigia **49**: 78–84, 1909.

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Contribution a l' étude des champignons parasites de Colombie. In Fuhrmann, O. Voyage d' exploration scientifique en Colombia. Mem. Soc. Newclat. Sci. Nat. **5**(2): 432–441, 1914.

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Fungi amazonici a cl. E. Ule lecti Ann. Mycol. **14**: 65–97, 1916.
Taxonomic; Records *Ustilago Panici-petrose*, *U. venezuela*, *Valsonectria orbiculata* as new species.

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Novae fungorum species. (New fungi species) Ann. Mycol. **15**: 143–148, 1917.

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Rust of British Guiana and Trinidad. Mycologia **17**(6): 255–262, 1925.

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Fungi chilensis a cl. E. Werdermann. lecti. Ann. Mycol. **26**(½): 100–126, 1928.

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Novae fungorum species XIX. Ann. Mycol. **26**: 133, 1928.

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Fungi Costaricenses a cl. prof. Alberto M. Brenes collecti Ser. I. An. Mycol. **27**: 1–86, 1929.

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Fungi venezuelani, Ann. Mycol. **23**(½): 29–224, 1930.

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Fungi chilensis a cl. E. Werdermann lecti. Ann. Mycol. **30**: 81–90, 1932.

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Novae fungorum species XXI. (New fungi species, XXI.) Ann. Mycol. **30**: 91–117, 1332.

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Novae fungorum species—XXII. (New fungi species XXII.) Ann. Mycol. **33**: 286–299, 1934.

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Fungi venezuelani—Additamentum. (An addition to Venezuelan fungi.) Ann. Mycol. Berl. **33**(1–2): 85–100, 1935.
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Tamayo,
La epifitia cocoteros. Rev. Agric. (Cuba) **9**: 557–558, 1889.

Tehon, L[eon] R[oy]
Studies of some Porto Rican fungi. Bot. Gaz. **67**(6): 501–511, 1919.

Téllez, Oliverio
La mancha de hierro en los cafetales de Oaxaca. (The "iron stain" of the coffee trees in Oaxaca.) Bol. Dir. General Agric. (Mexico) 1(7): 671–680, 1911.

Las anguilulas de las raíces del cafeto. (The coffee root nematodes.) La Hacienda **7**(4): 119–121, (5): 147–148, 1912.

Description of the coffee-root nematode *Heterodera radicicola* and the favorable conditions for its development. Discussion on control methods. Among the substances tested were: carbon sulfocarbonate, carbon bisulfate, soap mixtures, petroleum and tobacco. The best results were obtained with lime carbide.

Una plaga en el estado de Jalisco: La "pinta" o clavo de la naranja y de la guayaba. (A pest in the State of Jalisco: The "spot" or knob disease of the orange and guava.) Rev. Agric. (México) **6**(11): 651–652, 1922.

The disease is caused by *Gloeosporium psidii*.

Thierry, A. J.

Notes sur le greffage et la maladie vermiculaire du caféier. (Notes on grafting and the vermicular disease of coffee.) Bull. Agric. Martinique, 1899.

Tempany, H. A.

The root disease of sugar cane in Antigua. West Indian Bull. **10**(4): 343–347, 1910.

A discussion of *Marasmius sacchari*.

Thaxter, Roland

New or critical *Laboulbeniales* from Argentine. Proc. Amer. Acad. Arts & Sci. **48**: 155–223, 1912.

Theissen, Ferdinand

Xylariaceae austro-brasiliensis. Ann. Mycol. **7**: 1–18, 140–167, 1909.

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Hypocreaceae riograndenses. Broteria **9**: 121–147, 1910.

Die hypocreaceen von Río Grande do Sul, Sudbrasilien. (The *Hypocreaceae* from Río Grande of the South, South Brazil.) Ann. Mycol. **9**: 40–73, 1911.

Fragmenta brasilica. Ann. Mycol. **6**: 531–535, 1908; **7**: 343–353, 1909; **8**: 452–463, 1910; **10**: 1–32, 159–204, 1912.

Hemisphaeriales. Ann. Mycol. **11**: 468–469, 1913.

Annotacaes a mycoflora brasileira. (Annotation to the Brasilian microflora.) Broteria **12**: 13–31, 1914.

Mycologische Mitteilungen. (Mycological notes). Ann. Mycol. **16**: 184, 1918.

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Theissen, S. J., & Sydow, Hans

Die Dothideales. Ann. Mycol. **13**: 149–746, 1915.

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Synoptische Tafeln. Ann. Mycol. **15**: 389–491, 1917.

Thistelton-Dyer, William T.

Note on the sugar cane disease of the West Indies. West Indian Bull. **2**(3): 211–216, 1901.

This paper contains a historical discussion of the rind disease of sugar cane and a brief discussion of root diseases.

Thomas, H. E.

Vegetable diseases. Vanilla diseases. Citrus diseases. Puerto Rico Agric. Expt. Sta. Report **1917**: 28–30, 1918.

Brief notes on several diseases and tho fungi causing them.

Cultures of *Aecidium tubulosum* and *A. passifloricola.* Phytopathology **8**(4): 163–164, 1918.

Thompkins, R. G.

Wastage in banana transport. Trop. Agric. (Trinidad) **8**(10): 255–264, 1931.

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Thorold, C. A.

A further preliminary list of Trinidad fungi. Govt. Printing Off. Port of Spain. 30 p., 1931.

Fusarium wilt disease of sun hemp II. Trop. Agric. (Trinidad) **8**(7): 176–177, 1931.

Thümen, Félix von

De fungis enterianis observaciones. Separat-abdrack aus: Dr. Don P. G. Lorentz. "La vegetación del nordeste de la Provincia de Entre Ríos." Buenos Aires (Argentina) p. 99–102, 1878.

Pilzen aus Entre-Ríos. (Fungi from Entre-Ríos.) Flora **63**: 30–31, 1880.

Thurston, Jr. H[enry] W[infred], & Kern, F[rank] D[unn]
Distribution of West Indian rusts. Mycologia **25**(1): 58–64, 1933.

Tims, E. C., & Mills, P. J.
Some fungi associated with the root disease of sugar cane in Louisiana. Ref. Book & Sugar Ind. of the World. **5**: 33–37, 1927.

Give a discussion of *Marasmius plicatus, Rhizoctonia* and *Pythium.*

Tonduz, Adolfo
Informe sobre la enfermedad del cafeto. (Report on the coffee disease.) San José (Costa Rica) Inst. Fis. Geo. Nac. Ser. Bot. 28 p., 1893.

Discussion of a disease of coffee named in Costa Rica the "spot", which causes the falling of the leaves and berries.

Enfermedades del cafeto. El "chasparro" de las ramillas del cafeto. (Coffee diseases. The "chasparro" of the coffee-tree twigs.) Costa Rica Mem. de Fomento **1913**: 380–381, 1914.

Brief description of a coffee disease in Costa Rica, named the "chasparro". It causes a die back of young twigs of coffee.

Toro Rafael A[ndrés]
Una lista de los Pirenomycetes coleccionados en Puerto Rico por F. J. Seaver y C. E. Chardon. (A list of the Pyrenomycetes collected in Puerto Rico by F. J. Seaver and C. E. Chardon.) Rev. Agric. Puerto Rico **13**(5): 319–332, 1924.

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Continuation of previous work on the coffee-root disease and a leaf spot caused by the fungus *Cercospora coffeicola* Berk. & Curt.

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Nuevas enfermedades de la palma de coco en Puerto Rico. (New coconut palm diseases in Puerto Rico.) Rev. Agric. Puerto Rico **26**(8) : 42–44, 1931.
Popular account of four coconut palm diseases.

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Enfermedades y pestes observadas en los cultivos de la Montaña Central, Departamento de Junín, Húsnuco.) (Diseases and pests observed in the central mountain crops. Department of Junín, Húsnuco.) Est. Expt. Agron. de la Soc. Nac. Agraria, Lima, Perú. Informe 1, 1927.

Townsend, C[harles] O[rrin]

An immune variety of sugar cane. Science **49**(1276): 470–472, 1929.

Refers to work of F. S. Earle on Kavangire.

Trujillo Peluffo, Augustín

El Oidium y modo de combatirlo. (*Oidium* and the method of combating it.) Defensa Agric. (Uruguay) **1**: 120–121, 141, 1920.

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Desarrollo de las enfermedades criptogámicas en los viñedos durante el presente año. (Fungous diseases in the vineyards during the present year.) Defensa Agric. (Uruguay) **2**: 43–46, 1921.

A report on powdery mildew (*Oidium*), *Anthracnose* (*Gloeosporium*) and downy mildew (*Plasmopara*).

Uruguay: Pests and diseases of plants. Int. Bull. Plant Protec. **10**(2): 29–30, 1936.

Brief notes on several diseases of economic plants.

Tucker, C[larence] M[itchell]

Report of the acting plant pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rept. **1922**: 16–18, 1924.

Reports a *Helminthosporium* on rice and *Fusarium cubense.*

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Refers to *Fusarium cubense, Sporotrichum citri, Bacterium solanacearum, Fusarium lycopersici* and *Fusarium* sp. on vanilla.

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Popular.

Coconut but rot experiments in Porto Rico. Science n. s. **61** (1572) : 186–187, 1925.

A brief note stating that a small chlamydospored strain of *Phytophthora faberi* Maublanc had been isolated from coconut palms infected with coconut-bud rot.

La enfermedad de la raíz del cafeto en los semilleros. (Coffee root disease in the nurseries.) Rev. Agric. Puerto Rico **13** (3) : 129–131, 1926.

Brief notes describing the disease and giving preventive methods.

Enfermedad negra de los semilleros de las raíces del cafeto. (Black disease of the coffee root in the seed beds.) Puerto Rico Agric. Expt. Sta. Agric. Notes **23**, 2 p., 1926.

Brief notes discussing the disease and giving preventive methods. Much the same as the preceding.

A leaf, bract and boll spot of sea-island cotton caused by *Helminthosporium gossypii* n. sp. Journ. Agric. Res. **32**(4) : 391–395, 1926.

A description of the disease and the fungus.

Phytophthora but rot of coconut palms in Puerto Rico. Journ. Agric. Res. **32**(5) : 471–498, 1926.

A comprehensive paper on this disease which is due to *Phytophthora palmivora.*

Report of the Plant Pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1925** : 24–40, 1927.

Reports- *Fusarium* sp. on vanilla, experimental studies with *Phytophthora, Rhizoctonia ferruginea* on sugar cane and *Cajanus indicus* and other common diseases.

Report of the plant pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1926** : 28–30, 1927.

A report on the campaign for the eradication of coconut bud-rot which is caused by *Phytophthora palmivora.* The hat palm (*Sabal causiarum*) was found to be infected. Reference is also made to a root disease of vanilla due to a fungus similar to *Fusarium batatis* and to an anthracnose of the pod of the pigeon pea caused by *Collетotrichum cajani.*

Pigeon pea anthracnose. Journ. Agric. Res. **34**(6) : 589–596, 1927.

Colletotrichum cajani was found attacking *Cajanus indicus.*

Sabal causiarum (Cook) Beccari: A new host of the coconut bud-rot fungus. Journ. Agric. Res. **34**(9) : 879–888, 1927.

The disease is caused by *Phytophthora palmivora*. This fungus will attack several other host plants, especially when they are wounded.

Vanilla root rot. Journ. Agric. Res. **35**(12) : 1121–1136, 1928.

The fungus is described as *Fusarium batatis* var. *vanillae*.

Report of the plant pathologist. Puerto Rico. Agric. Expt. Sta. Ann. Rpt. **1927**: 25–27, 1929.

Report of the plant pathologist. Puerto Rico. Agric. Expt. Sta. Ann. Rpt. **1928**: 29–35, 1929.

Enfermedades del cafeto en América. (Coffee diseases in America.) Bol. Unión Panamericana **62**: 1020–1034, 1928. (Rev. Agric. Puerto Rico **22**(7) : 27–31, 1929.

The coffee diseases which the author describes and gives distribution are: black-root disease (*Rosellinia bunodes* (B. & Br.) Sacc.), white-root disease, "iron stain", thread blight (*Corticium koleroga* (Cooke) Höhm.), spot of the berry (*Cercospora coffeicola* Berk. & Curt.), and *Sclerotium* disease (*Sclerotium coffeicolum* Stahel.)

Report of the plant pathologist. Puerto Rico Agric. Expt. Sta. Ann. Rpt. **1929**: 24–25, 1930.

Taxonomy of the genus *Phytophthora* de Bary. Missouri Agric. Expt. Sta. Res. Bull. **153**, 208 p., 1931.

The distribution of the genus *Phytophthora*. Missouri Agric. Expt. Sta. Res. Bull. **184**, 80 p., 1933.

Unamuno, L. M.

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A Latin diagnosis is given of *Septoria americana* Frag. & Herrera on Willow (*Salix* sp.) from México.

Urban, Ignacio

Bibliographia Indiae occidentalis botanica contimatio II. Symb. Ant. **3**: 1–13, 1902.

Bibliographia Indiae occidentalis botanica contimatio III. Symb. Ant. **5**: 1–16, 1904.

Urich, F. W.

Miscellaneous notes. Trinidad Bd. Agric. Circ. **3**: 15–25, 1911.

Notes on the fungoid and insect pests. Proc. of the Soc. of Trinidad and Tobago **13**(4): 186–187, 1913.

A brief paper in which the author refers to cacao canker (*Phytophthora*) and brown rot (*Diplodia*) and chupon wilt of cacao.

Fungoid and insect pests. Soc. paper **554**. Proc. Agric. Soc. Trinidad & Tobago **13**(4): 186–187, 1913.

Popular. Mentions *Phytophthora* and *Diplodia* of cacao.

Utra, Gustavo d'

A molestia do "mosaico" do fumo (Mosaico disease of tobacco.) Bol. Agric. Sao Paulo (Brasil) **5**(2): 51–71, 1904.

Valle Zeno, Rafael del

Mottling or yellow stripe disease of sugar cane. Some facts relative to the importance of the discovery of the "morbid" cause. Published privately with 2 color plates by author, New York, 1919.

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Vélez, Ramón

El mosaico del tabaco. (Tobacco mosaic.) Rev. Agric. Puerto Rico **10**(2): 25–26, 1923.

A brief popular discussion.

Verteuil, J[oseph] de, & Brunton, L. A.

Sugar cane experiment, 1919–1922. Trinidad and Tobago Dept. Agric. Bull. **19**(4): 188–214; **20**(2–4): 65–109, 1922.

Veve, R[afael] A.

The eradication of sugar-cane mosaic in Fajardo. Ins. Expt. Sta. Puerto Rico Circ. **33**: 52–55, 1920.

La represión del matizado en Fajardo. (Mosaic eradication in Fajardo.) Rev. Azucarera & Agricultura, Puerto Rico. **1**: 96–98, 1921.

The efficiency of "Roguing" method for the eradication of mottling disease. Louisiana Planter **69**(2): 30, 1922.

The disease was reduced from 0.5 to 0.002 per cent. Believes that roguing can be practiced where the percentage of disease is less than 15 per cent.

Cane mottling eradication. Facts About Sugar **15**(4): 78, 1922.

Overcoming the mosaic disease at Fajardo. Facts About Sugar **18**(20): 468, 1924.

Mosaic has been overcome by roguing.

Vincens, F.
Necrose nes fuilles de pin due an *Pestalozzia truncata* Leveille. (Necrosis of pine leaves caused by *Pestalozzia truncata*) Bull. Soc. Path. Veg. France **5**: 27–31, 1918.

This fungus attacks *Pinus sylvestris*. It is believed to be same as *P. hastigii*.

Quelques maladies desplantes an Para, Brasil. (Some diseases of cultivated plants of Para, Brazil.) Bull. Soc. Path. Veg. France **5**: 45–55, 1918.

Discusses *Cercospora nicotianae*, *C. orizae*, *Lasiodiplodia theobromae*, *Phyllosticta theobromicola* n. sp. *Gloeosporium theobromicolum* n. sp. and *Dendrodochium paraense* n. sp.

Vidal, L. F.
El mosaico de la caña de azúcar. (Mosaic of sugar cane.) Tipografía Cercantes, San Pedro de Macoris, Rep. Dominicana. 44 p. 1931. (Facts About Sugar **26**: 503, 1931. Brasil Açucareiro **9**(5): 348–354, 1937.)

A popular text-book.

Viola, P., & Pacottet, P.
Nouvelles recherches sur l'anthracnose. Bur. Rev. Viticola 65 p., Paris, 1905.

Vizioli, José
Estudido preliminar da molestias das folhas do cafeiro causadas pela *Hemileia vastatrix*. (Preliminary studies on the coffee-leaf disease caused by *Hemileia vastatrix*.) Bol. Agric. Sec. Agr. Com. & Obras Pub. S. Paulo, 23(3–4): 87–118; (5–6): 152–188, 1923.

This very interesting paper deals with a rather extensive general discussion on the fungus *Hemileia vastatrix*, which is unknown in the Western Hemisphere. Includes a bibliography of 55 titles.

Some Pyrenomycetes of Bermuda. Mycologia **15**(3): 107–119, 1923.

W. G. F. [Freeman]
An algal disease of cacao. *Cephaleuros virescens*. Dept. Agric. Trinidad & Tobago. Bull. **13**(83): 263–264, 1914.

A brief popular discussion.

Wakefield E[loise] M[aud] (E. M. W.)
Mosaic disease of cane. Sugar **23**: 500–501, 1921.

Bracket fungi disease. Agric. News **19**(487): 414, 1920.

Refers to the subject and to *Ganoderma lucidum* (*Fomes licidus*) in roots of limes in Monserrat and Antigua.

Mosaic disease of plants. West Indian Bull. **18**(4):197–206, 1921.

Walker, M[arion] N[ewman,] & Stahl, C[orwin] F[loyd]

Certain grass hosts of the corn aphid considered in relation to their occurrence in Cuba. Trop. Plant Res. Foundation Bull. **5**: 318, 1926. (Rev. Appl. Ent. Ser. A. **15**: 379, 1926.)

This paper gives the results of studies of sugar-cane mosaic on other hosts.

Walters, E. A.

Die-back of limes (*Citrus medica* var. *acida.*) Proc. Ninth West Indian Agric. Conf. **1924**: 232–234, 1925.

Observations made in St. Lucia.

Report of the Agricultural Dept. of St. Lucía (West Indies) **1925**: 33, 1926.

Contains records of several common diseases: *Marasmius sacchari*, Wakker, *Leptosphaeria sacchari*, Br. d. H., *Cercospora vaginae* K. and *Bacterium vascularum* (Cobb.) (E. F. S.) Also *Phytophthora* and *Diplodia* of cacao and bud rot of coconut, *Gloeosporium limetticolum* Clausen of lime and *Fusarium cubense* E. F. S. of banana. *Rosellinia* on cacao roots. Little leaf, stem bleeding, wilting leaf and leaf yellows, bitten leaf and senility of coconut.

Control of fungus diseases. West Indies Imp. Dept. Agric. St. Lucía Dept. Agric. Ann. Rpt. **1926**: 10–11, 1927.

Report on the Agricultural Department of St. Lucía, **1933**: 18–19, 1934.

Notes on the following crop diseases: limes, oranges, cacao, grapefruit and coconuts.

Report of the Agricultural Department of St. Lucía **1934**: 16–19, 1935.

This report includes notes on red root of limes (*Sphaerostilbe repens*), wither-tip (*Gloeosporium limetticolum*), coconut-bud rots (*Phytophthora palmivora*) and a coconut little leaf, banana Panama disease (*Fusarium oxysporum cubense.*)

Report on the Dept. Agric. St. Lucía, **1935**: 30–32, 1936.

Account of the Panama disease of bananas in the Island,

Ward, H. Marshall

Report on specimens of diseased amount. Kew Bull., **1893**: 203, 1893.

Wardlaw, C. W. & McQuire L[awrence] P[atrick]

Panama disease of bananas. Empire Marketing Board, Rep. 20, 1929.

Panama disease research. Trop. Agric. (Trinidad) **6**(7): 192–197, 1929.

This paper is a summary of two reports by the author submitted to the Empire Marketing Board. It gives a review of the results obtained by the author.

Witch-broom in Suriname. Trop. Agric. (Trinidad) **6**(12): 348–349, 1929.

A short paper on a disease of cacao which the author attributes to *Marasmius perniciosus.*

Banana-fruit disease. A review of the literature of fungal diseases of banana fruits. Trop. Agric. (Trinidad) **7**(5): 115, 1930.

Panama disease research (*Fusarium cubense.*) Trop. Agric. (Trinidad) **7**(10): 278–281, 1930.

A discussion of results.

Banana-fruit disease. Trop.Agric. (Trinidad) **7**(10): 285, 1930.

A brief note in which the author says: "In a review of literature on Banana fruit diseases published in Vol. VII, No. 5 of this Journal. *Cercospora musae* and *C. musarum* both of which are banana leaf-splitting fungi, were wrongly regarded as identical. Mr. S. F. Ashby of the Imperial Bureau of Mycology has kindly supplied the following information: "*Cercospora musae* Zimm. (*C. musae* Mass.) Appears to be restricted to the East-Ceylon, Jaya, some Pacific Islands and Australia, while *C. musarum,* Ashby, which is a distinct species is known only from South America, the West Indies and West Africa. The new name *Helminthosporium torulosum* (Syd.) comb. nov. has been proposed for the latter species.''

The biology of banana wilt (Panama disease). I. Root inoculation experiments. Ann. Bot. **44**(175): 741–766, 1930.

Studies on this disease which is due to *Fusarium cubense.*

The biology of banana wilt. (Panama disease.) II. Preliminary observations on sucker infection. Ann. Bot. **44(176): 917–**956, 1930.

A report on extensive studies of this disease which is caused by *Fusarium cubense.* Continuation of previous works.

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The behaviour and diseases of the banana in storage and transport. Empire Marketing Board Report **36**, 74 p., 1931. H. M.S.O., (Trop. Agric. (Trinidad) **7**(7): 183–189, 1930).

A preliminary discussion and results of experiments. The following fungi were observed at low temperature: *Thielaviopsis paradoxa*

(De Seyres) von Hohn., *Ceratostomella paradoxa* (Dade.), *Gloeosporium musarum* (Cke. & Massee), *Botryodiplodia theobromae* (Pat.), *Phomopsis* sp. *Acremoniella* sp., *Eidemia* sp. *Verticillium* sp., and *Fusarium* spp.

----------, **& McQuire, Lawrence P[atrick]**
Panama storage. The behaviour and diseases of the banana in storage and transport with special reference to chilling. Trop. Agric. (Trinidad) **8**(6) : 139–147, 1931.

A report.

Panama disease. I. Observations on *Botryodiplodia* fruit rot of the banana. Trop. Agric. (Trinidad) **8**(9) : 227–230, 1931.

A description of the disease caused by *Botryodiplodia theobromae*. Also a description of the organism.

Banana diseases. II. Notes on "cigar-end" (*Stachylidium theobromae* Turc.) Trop. Agric. (Trinidad) **8**(11) : 293–298, 1931.

The cigar end is caused by *S. theobromae* and the black tip by *Helminthosporium torulosum (Cercospora musarum)*.

Banana diseases. III. Notes on the parasitism of *Gloeosporium musarum* (Cook & Massee). Trop. Agric. (Trinidad) **8**(12) : 327–331, 1931.

A discussion of the fruit rot caused by *G. musarum*.

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Transport and storage of banana with special reference to chilling. E.M.B. Report No. **45**, 1931.

The biology of banana wilt III.—An examination on sucker infection through root bases. Ann. Bot. **45**(179) : 381–399, 1931.

----------, **& McQuire, Lawrence P[atrick]**
Pitting disease of bananas. Its nature and control. Trop. Agric. (Trinidad) **9**(6) : 193–195, 1932.

This disease also occurs in Brazil. It appears to be due to *Piricularia grisea* (Cke.) Sacc. The author gives a discussion of the disease and the fungus.

Fusarium cubense. Trop. Agric. (Trinidad) **8**(3) : 54–60, 1931.

A very complete discussion of studies on this fungus.

----------, **& McQuire, Lawrence P[atrick]**
The behaviour and diseases of the banana in storage and transport. Proc. 1. Imp. Hort. Conf. London **1930**(3) : 52–60, 1930. (Trop. Agric. (Trinidad) **8**(6) : 139–147, 1931.)

————————, **& McQuire, Lawrence P[atrick]**
Control of wastage in bananas with special reference to time and temperature factors. E. M. B. Report No. **60**, 1932.

Observations on the *Pycnidium* of *Botryodiplodia theobromae* Patt. Ann. Bot. **46**(182): 229–238, 1932.

————————, **& McQuire, Lawrence P[atrick]**
The storage of tropically grown tomatoes. Empire Marketing Board Publ. **59**, 50 p., 1932.
Temperature studies.

Banana diseases. IV. Notes on "black-tip" disease in Trinidad; *Helminthosporium torulosum* (Syd.) comb. nov. Ashby. Trop. Agric. (Trinidad) **9**(1): 3–6, 1932.
A continuation of former studies.

Banana diseases. IX. The occurrence of Sigatoka disease (*Cercospora musae*) Zimm.) on Banana in Trinidad. Trop. Agric. (Trinidad) **9**(7): 173–175, 1932.
The first record of the disease in Trinidad.

————————, **& McQuire, Lawrence P[atrick]**
Preliminary observations on the storage of limes, with a note on the king orange. Trop. Agric. (Trinidad) **10**(7): 190–191, 1933.
Storage trials in which *Penicillium* was an important factor.

Notes on a *Fusarium* tip-rot of immature Cavendish fruits. Trop. Agric. (Trinidad) **10**(1): 6, 1933.
This paper refers to cigar end *Stachylidium theobromae* and black tip *Helminthosporium torulosum* (Sydow) com. n. Ashby.

————————, **Leonard, E. R. & Baker, R. E. D.**
Observations on storage of various fruits and vegetables. I. tomatoes, cauliflower, string beans, egg plant, cucumber and muskmelons. II Papaws, pineapples, granadillas, grapefruit, and oranges. Trop. Agric. (Trinidad) **9**(8): 196–200, (9): 230–235. 1932.
A study of low temperature. Refers to the following fungi: *Colletotrichum lagenarium, Fusarium* spp., including *F. succisae, Mycosphaerella citrulina, Cladosporium cucumerinum* and *Macrosporium cucumerinum (Alternaria cucumerina), Phomopsis papayae, Fusarium dimerum* var. *pusillum, Penicillium italicum, P. digitatum, Phomopsis (Diaporthe) citri* and *Colletotrichum gloeosporioides.*

Panama disease. A review of the occurrence of Panama disease in the Cavendish or dwarf banana. Trop. Agric. (Trinidad) **10**(6): 151–154, 1933.
A discussion of the cause, spread and treatment of the disease.

---------, & **McQuire, Lawrence P[atrick]**

Tomato storage. Further observations on the storage of tropically grown tomatoes. Trop. Agric. **10**(6) : 161–163, 1933.

In the latter paper the author gives a list of fungi and bacteria found in rejected fruits.

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Cultivation and diseases of the banana in Brazil. Part II. Diseases. Trop. Agric. (Trinidad) **10**(8) : 211–217, (9) : 255–259, 1933.

This paper is based on investigations in Sao Paulo. The discussion includes (9) an infectious chlorosis transmitted by *Pentalonia nigronervosa* which is unlike the bunchy top of Australia; (10) brown rot of bulbs of unknown cause; (11) a stem-root rot caused by *Marasmius semiustus;* (12) a black-head disease of unknown cause; (13) debility resulting from unfavorable planting conditions; (14) a leaf-spot disease in which a fungus (*Scolecotrichum musae* Zimm.) was found; (15) a black finger tip disease believed to be due to sunscorch and (16) a pitting disease.

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Banana storage. An account of recent investigations into the storage behavior of several varieties. Trop. Agric. (Trinidad) **10**(12) : 336–339, 1933. (E. M. B. Report No. **72**, 1933.)

Banana diseases. VI. The nature and occurrence of pitting disease and fruit spots. Trop. Agric. (Trinidad) **11**(1) : 8–13, 1934.

A very excellent discussion of this disease from which several fungi have been isolated.

Banana diseases. VIII.—Notes on various diseases occurring in Trinidad. Trop. Agric. (Trinidad) **11**(6) : 143–149, 1934.

A discussion of methods and a list of fungi that were isolated.

Banana disease. VIII.—Notes on various diseases occurring in Trinidad. Trop. Agric. (Trinidad) **11**(6) : 143–149, 1934.

Continuation of the author's notes on banana diseases. Gives description of the disease and spread.

Banana diseases. IX.—The occurrence of Sigatoka disease (*Cercospora musae* Zimm.) on Bananas in Trinidad. Trop. Agric. (Trinidad) **11**(7) : 173–175, 1934.

In this paper the author reports the recent discovery of *Cercospora musae* Zimm. on bananas in Trinidad. This is the first record of this fungus occurring in the American Tropics.

-------------, **& McQuire, Lawrence P[atrick]**

The storage of West Indian mangoes. Mem. Low Temp. Res. Sta. (Trinidad) **2.**, 47 p., 1936.

The authors found in their investigations that there is a close relation between mango anthracnose (*Gloeosporium mangiferae*) and the physiology of ripening. The disease is also manifested as a blight on the flowers and setting of fruits. An account is also given of the blemishes produced by *Pestalozzia funerea* and a *Phomopsis.*

Watts, Francis

On legislating against plant diseases. West Indian Bull. **15**(3): 158–161, 1915.

Withertip disease of limes. Agric. Dept. (Dominica) Rept. **1922–23**: 10–16, 1923.

A report on this disease which is attributed to *Colletotrichum gloeosporioides.*

Weir, James Robert

A pathological survey of the Para rubber tree. (*Hevea brasiliensis*) in the Amazon Valley. U. S. D. A. Bull. **1380**, 130 p., 1926.

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This tree is attacked by *Ganoderma pulverulentum* and *Ustulina zonata.*

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MELVILLE T. COOK, Editor

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TWO EARLY PUERTO RICAN HERPETOLOGISTS

CHAPMAN GRANT, U. S. Army, Retired.

I. Dr. Augustín Stahl

Augustin Stahl was born in Aguadilla, Puerto Rico, in 1842, the son of a German father and a Dutch mother. He graduated from Wurtzburg as an M.D. in 1864 and resided in Bayamón from 1865 until his death in 1917.

Dr. Stahl's passion was natural history. Most of his work was in botany or ethnology. His collection of fauna numbered nearly four thousands specimens, on which he wrote four volumes in the nature of a catalogue. Herpetology was not his strong forte, as is evident by the scant space given it in his works. His greater interest in other branches doubtless accounts for his not marking the wealth of unclassified forms about him.

Dr. Stahl is kindly remembered in Puerto Rico, as well as by scientists of international fame who have named species of many classes in his honor. Unfortunately his reptile collection, together with his correspondence with Gundlach and other herpetologists is lost. He did not describe any new species, but was the first to record *Caretta caretta* from Puerto Rican waters, the twenty-fifth species listed of the fifty-two now known to occur on Puerto Rico or contiguous thereto.

The inaccessibility of Dr. Stahl's books pointed to the advisability of making the appropriate parts available to interested herpetologists. This is done gratefully with the memory of two delightful years of herpetological study in Puerto Rico following in the footsteps of Augustin Stahl, the pioneer; Francisco del Valle Atiles, the tolerant and Leonhard Stejneger, the scholar.

A comprehensive appreciation of Dr. Stahl was written by Chancellor Carlos E. Chardón in "La Revista de Agricultura de Puerto Rico" **12**: 65–84, 1924.

We turn to Dr. Stahl's work and find on—

Pages 5–9 the *"Advertencia"*; a pertinent part revealing the noble character of the modest pioneer reads:

"... ofrecer una clasificación de los animales de Puerto Rico para facilitar el conocimiento de ellos á los aficionados, despertar en la juventud estudiosa por medio de este libro la afición á las investigaciones en el inagotable campo de la Historia Natural, y en particular de nuestra fauna, iniciándoles en estudios apenas practicados en el país por falta de una guía práctica, la que pretendemos ofrecer en este trabajo, primero y único en su clase en Puerto Rico."

"Indudablemente que la obra ha de resentirse de los defectos propios á todo trabajo que por primera vez se ejecuta: el tiempo traerá otros más competentes que se encargarán de rectificar y completar nuestra obra imperfecta."

Bayamón, Febrero de 1882. Dr. A. Stahl.

Page 23—

"El Dr. Guillermo Peters, director del Museo zoológico de Berlín, dá á conocer en Sitzung der physikalisch mathematischen Klasse del 13 de Noviembre de 1876 inserto en la obra que se lee en Autores los mamíferos y reptiles que le fueron enviados por el Sr. Krug ... Los reptiles, que me son todos conocidos, á excepción del *Anolis Krugii,* dejan un vacío por la falta de los testudinados marinos. Posteriormente he encontrado una nueva especie de los *Geckones,* y hecho estudios más detenidos sobre la embiología del *Coquí, Hylodes martinicensis,* que he remitido á Berlín." *

The ". . *estudios — — sobre la embiología del Coquí* . ." was first written up by Bello y Espinoza en 1871.

Page 36—

CUADRO SINÓPTICO de las 12 clases del reino animal, dividido en tres grupos ... B. Sangre fría; corazón con un ventrículo y una ó dos aurículas. Huevos casi siempre coriaceos; con ó sin metamórfosis; respiración pulmonar, en los anfibios branquial en la primera edad; desnudos ó escamosos; 4 ó 2 ó ningunas extremidades (Coquí, Iguana) ... III.-Reptiles. *(Reptilia)*".

Page 68: NOTES—The page should commence:

"Ord. I. Testudinados (*Testudinata*)." to conform to the rest of the text. Line 6: "Morrocollo". The tortoise mentioned here is probably the last time it appears in literature of Antillean herpetology until the July 1932, Jour. Dept. Agri., P. R. H. West mentions its occurrence as early as 1793. It is now found feral on several keys of the Virgin Island group and has as much right to a place in Antillean herpetology as *Iguana* which is supposed to have been introduced in pre-Columbian times by the Caribs for food. The word "morrocollo" means latrine cleaner; this reptile was kept for this purpose. Line 7; "Costa Firme" refers to the North Coast of Venezuela and Columbia. Line 25; "Es pequeña" referring to *C. caretta* must relate to a specific small specimen in Dr. Stahl's collection. Page 70; NOTES; Line 28; *"Culebra sabanera (Dromicus)."* Dr. Stejneger named this species *Leimadophis stahli* in 1904 with the remark: "Dedicated to Dr. A. Stahl, of Bayamón, the venerable Porto Rican patriot and naturalist, from whom I received the type specimen."

* NOTES: The *"Geckones"* mentioned is *Hemidactylus brookii.* The exact species was not known until 1932. See "The Hemidactyls of the Porto Rico Region" Jour. Dept. Agri. P. R. Vol. XVI, No. 1.

CATÁLOGO

DEL

GABINETE ZOOLÓGICO

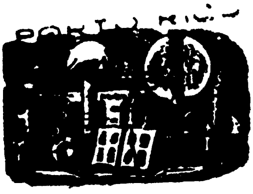
DEL

DR. A. STAHL,

EN BAYAMON (Pto.-Rico.)

Precedido de una Clasificación sistemática

de los animales que corresponden á esta fauna.



PUERTO-RICO.

IMPRENTA DEL "BOLETIN MERCANTIL."

87.-Fortaleza-87.

1882.

CL. III. REPTILES. (REPTILIA).

División de los Reptiles en cuatro órdenes.

No hay Metamórfosis. Cuerpo cubierto de escamas, ó escudos. **A.** *Escamosos.* *(Squamata).*

- Sin dientes; cuerpo corto y grueso y cubierto de grandes escudos, á los que se fijan las costillas. — *Quelonios ó Testudinados.* *(Testudinata).*
- Con dientes; cuerpo alargado.
  - Esternón y párpados. Mandib. inf. entera; 4 patas, raramente dos. cuerpo cubierto de escamas. — *Saurios.* *(Sauria).*
  - Sin esternón y sin párpados; mandib. inf. abierta por delante. — *Ofidios.* *(Ophidia).*

Metamórfosis. Cuerpo alargado ó corto, desnudo, piel glutinosa extremidades 4 ó 2 ó ningunas. *Batráquios* ó *Anfibios.* (*Batrachia*) **B.** *Desnudos.* (*Nuda.*)

A. Reptiles escamosos. (*Reptilia squamata*).

Las 4 extremidades igualmente largas.

- Dedos inmóviles, envueltos en una masa común, arredondeada (Morrocollo). — *Testudinidos.* (*Chersinæ*,
- Dedos unidos por membranas interdigitales, móviles. (Jicotea). — *Emididos;* (*Emydæ*).

(68)

Extremidades anteriores más largas que las posteriores; dedos en forma de remos. (Carey). *Quelonidos. (Chelonæ).*

FF. 1ª TESTUDINIDOS. (*Chersinæ*). Dedos envueltos en una masa comun y arredondeada, y se distinguen al exterior por las uñas; espaldar convexo y vientre en los machos con una depresion.

Morrocollo. *Testudo tabulata, imbricata* y *carbonaria*, son indígenas de las sabanas de Costa Firme y propagados en todas las Antillas.

FL. 2ª EMIDIDOS. (*Emidæ*). Dedos unidos por membranas interdigitales y provistos de uñas largas; espaldar poco covexo.

Jicotea. *Emys rugosa (decussata)*, Sharv. Oscura con los escudos algo verdosos con estrias y puntos amarillosos; parte inferior amarilla.

FL. 3ª QUELONIDOS. (*Chelonæ*). Extremidades torácicas mayores que las abdominales, todas ,en forma de remos, con los dedos ocultos bajo la piel; cabeza y extremidades no retractiles. Habitan el mar.

A. Cuerpo revestido de grandes placas córneas; dedos con uñas.

Tortuga. *Chelonia viridis*, Schn. Verde oscura, parte inferior amarillosa, carapacho algo comprimido y elevado el dorso. Su concha poco estimada.

Carey. *Ch. imbricata*, L. 13 placas variadas de amarillo y oscuro y concha muy estimada.

Caguama. *Ch. caretta*, L. 15 placas provistas de una quilla longitudinal en la primera edad. Es pequeña.

B. Cubierta del cuerpo coriácea; dedos sin uñas.

Tinglado. *Sphargis coriacea*, L. Color oscuro con 5 quillas longitudinales en el dorso. Muy grande. En la playa del Dorado, se vió salir un *tinglado* del mar, cavar un hoyo en un instante y depositar en él en pocos momentos *setenta* y *ocho* huevos.

ORD. 2º SAURIOS. (*Sauria*). Cuerpo alargado, cubierto de escamas ó escudetes; cuatro extremidades, á veces faltan dos ó todas ellas; ámbas mandíbulas y á veces tambien el paladar provistos de dientes; la mandíbula inferior se articula con el cráneo mediante el hueso timpánico; costillas movibles, esternón bien desarrollado en casi todas las especies; dos ó tres párpados, tímpano visible; á veces vejiga urinaria y pene doble casi siempre. Este órden es polimorfo en sus especies y presenta algunas analogías con los ofidios, más que los demás órdenes; los cocodrilos se aproximan á los mamíferos, los antibenidos á los ofidios, el *Platydactylus* á los sapos. Se alimentan de insectos y otros animales pequeños; son temibles las grandes especies, las pequeñas inofensivas, careciendo todas de dientes ponzoñosos ó vejiga venenosa. 7 *familias*.

1º Cuerpo cubierto de escudetes y escamas de gran consistencia. (Cocodrilo). *Cocodrilos. (Crocodilinæ).*

2º Cuerpo cubierto de escamas ó verrugas.

(69)

a. **Lengua protractil.**

1ª Lengua delgada y bífida, dedos desiguales en las 4 extremidades. (Lagartija). *Lacertidos.* (*Lacertini*).

2ª Glutinosa gruesa en la punta, 5 dedos iguales, cola prensil. *Camaleonidos.* (*Chamæleonidei*).

b. Lengua corta. 1ª Gruesa, verrugosa, no protractil; 4 extremidades siempre. *Iguanidos.* (*Iguanoidei*).

2ª Escotada en la punta; extremidades 4 ó 2 ó ningunas. *Escincoidos.* (*Scincoidei*).

3ª Escamas granuliformes, cuerpo deprimido, 4 extremidades, uñas retractiles y dedos en laminillas. (Salamandra). *Gecónidos.* (*Geckones*).

3º Cuerpo prolongado y protejido por escamas que forman círculo alrededor del tronco; extremidades cortas ó faltan completamente. (Culebrita ciega). *Anfisbénidos.* (*Amphisbaenæ*).

FL. 4ª COCODRILOS. (*Crocodilinæ*). No tiene representantes en P. R.

FF. 5ª LACERTIDOS. (*Lacertini*).

Ameiva Plei. Dum. Iguana. Una sola especie en P. R., muy grande, oscura con puntos y cuadros negros y blancos. En los arenales y pedregales.

FL. 6ª IGUANIDOS. (*Iguanoidei*).

Un solo género con varias especies en P. R.. *Lagarto.* (*Anolis*)

A. velifer. Cuv. Lagarto Camaleón. Verde con manchas oscuras y vientre amarilloso; el ♂ con cresta en el dorso; cambia sus colores, como sus congéneres.

A. Gundlachi. Pet. L. de Gundlach. Lomo oscuro. Vientre claro, cabeza mosqueada; el mayor de nuestros lagartos ordinarios.

A stratulus, Cope. L. tendido. Color del anterior, en el lomo varias manchas negras transversales.

A. cristatellus. Bib. L. de cresta. Color de los anteriores con faja clara á lo largo del lomo, con puntos negros al costado de esta faja.

A. pulchellus, Bib. L. hermoso. Muy esbelto; parte superior gris, la inferior blanca y garganta rojo amarilla.

A. Krugii. Pet. L. de Krug. No conozco aún esta especie.

FL. 7ª CAMALEONIDOS. (*Chamaeleonidei*).

No tiene representantes en P. R.

FL. 8ª ESCINCIDOS. (*Scincoidei*).

Representado en P. R. por la única especie. *Lúcia.* (*Diploglossus Plei*).

FL. 9ª GECÓNIDOS. (*Geckones*).

(70)

Única especie puerto-riqueña. *Salamandra. (Sphæriodactylus macrolepis).* Gunth.

FL. 10ª ANFISBÉNIDOS. *(Amphisbaenæ).*

Especie única de P. R. *Culebrita ciega, (Amphisbaena caeca).* Cuv

ORD. III. OFIDIOS. (*Ophidia*).

Boca pequeña, cabeza no excede en grosor al cuello. *Tiflopes.* (*Thyplopes*).

<table>
<tr><td rowspan="3">Boca grande, se abre más allá de los ojos; cabeza más ancha que el cuello. Euristomos. [Eurystoma].</td><td rowspan="2">Sin aparato venenoso; dientes fijos y casi iguales en los bordes de la mandíbula superior.</td><td>Surco intermaxilar poco visible y con escamas. Boas.</td><td>[Boæ].</td></tr>
<tr><td>Surco intermaxilar muy visible y con placas córneas. Colúbridos.</td><td>[Colubres].</td></tr>
<tr><td colspan="2">Bordes de la mandíbula superior provistos á cada lado de un diente acanalado, movible, sin más dientes, ó fijo y acompañado de otros dos, comunicando con una glándula venenosa. Viperidos.</td><td>[Venenosa].</td></tr>
</table>

FL. 11ª TIFLOPES. (*Typhlopes*).

La única especie que poseemos. *Culebra ciega.* (*Typhlops lumbicalis*). L.

FL. 12ª BOAS. (*Boæ*).

Un solo género en P. R. *Culebrón.* (*Chilabothrus*).

Ch. inornatus. Reinhardt. Color pardo con cuadros oscuros, vientre más claro.

FL. 13ª COLUBRIDOS. (*Colubres*).

Boca hendida hasta detrás del oido. *Culebra sabanera.* (*Dromicus*).

Boca hendida hasta el oido. *Culebrita.* (*Alophis*).

Dromicus parvifrons. Cope. Culebra sab. Color canelo oscuro con cuadros negros, vientre blanco.

Alophis portoricensis. Reinhardt. Culebrita. Color pardo claro;

B. DESNUDOS. (*Nuda*).

ORD. IV. BATRAQUIOS. (*Batrachia*)

FF. ANUROS. (*Anura*).

SUB-FL. RANAS. (*Ranæ*).

(71)

Solo género y sola especie en P. R. ***Sapo.* (*Cystignathus*).**

SUB-FL. BOMBINATORES.

Solo género y sola especie en P. R. ***Coquí.* (*Hylodes*.)**

SUB-FL. BUFOS. (*Bufones*).

Solo género y sola especie en P. R. ***Sapo concho.* (*Bufo*).**

***Cystignathus typhonius.* Daud. Sapo. Parte superior manchada de oscuro y rojizo, vientre blanco.**

***Hylodes martinicensis.* Thud. Coquí. Sobre el espinazo pasa una línea blanca que tiene sus ramales, y el vientre blanco, siendo la parte superior oscura.**

***Bufo gutturosus,* (*Peltaphryne*). Latr. Sapo concho. Amarillo sucio.**

Don Tomás Blanco, farmacéutico en P. R. y aficionado á la historia natural, ha encontrado allí una nueva especie de la familia de los Geckones que hemos observado más tarde en Aguadilla y otros lugares.

Notes on page 69:

Line 19: "*Ameiva plei*" is *A. exsul.*

Lines 24 et seq. "*A. velifer*" is *A. cuvieri.*

"*A. gundlachi* . . . el mayor de nuestros lagartos ordinarios." It is evident that he considered the male of *A. cristatellus* to be *A. gundlachi.* Below where he describes *A. cristatellus* it is obvious that he has the female only in mind.

Next to last line. "*Diploglossus plei*" is *Mabuya nitida.*

APENDICE

La Preñez en Ciertos Peces y Reptiles

Agregamos por vía de apéndice, como conclusión de la primera parte de la obra, dos curiosas observaciones sobre la preñez en ciertos peces y reptiles.

[126]

"Distante estaba de creer que en breve debería hacer aquí la misma observación con nuestra *Boa ó Culebrón "Chilabothrus inornatus."* Esta, el *Majá de Sta. María* de la isla de Cuba, "*Epicrates angulifer,*" y algunos otros reptiles, se desvían de la regla ordinaria, y de ovíparos se convierten en vivíparos. Al regresar de Cuba en Junio del próximo año, recibí de regalo de mi amigo D. Tomás Blanco, aficionado al estudio de la historia natural, un culebrón hembra que había tenido guardado cerca de un mes, y yo lo dí de compañero á un Majá cubano que guardaba en su buena jaula. Cuál sería mi sorpresa cuando á fines de Setiembre, es decir, á los cuatro meses de haber tenido la boa guardada y libre del contacto con el macho, la encuentro rodeada de una numerosa prole consistente en 25 hijos recién nacidos y vivos, como de una cuarta de largo por un centímetro de ancho, con los colores de la madre, llevando aún trozos del cordón umbilical. En el suelo de la jaula habían varios pedazos más ó menos grandes de una masa consistente, aunque algo blanda y amarilla, parecidas á pedazos de jabón amarillo, probablemente trozos de la placenta."

Note to page 126. Dr. Stahl was not aware that certain reptiles are ovoviviparous. His allusion to a placenta is a slip not to be held against him.

"Pero es el caso, que en los reptiles parece que la regularidad consiste en la irregularidad, así lo prueban las experiencias del Dr. Gundlach con los huevos del Morrocoyo, y últimamente la observación hecha por mí con otro culebrón que parió á mediados de Octubre y á los cuatro meses de su cautiverio."

II. Dr. Francisco del Valle Atiles

The small brochure by Dr. Francisco del Valle Atiles is not a copy of Stahl. His systematic classification shows improvement over the earlier writer. He also understood that certain reptiles are ovoviviparous. He omits "*Testudo tabulata, Caretta caretta* and *Diploglossus sagrae*" which were included by Stahl and adds *Alsophis portoricensis* which Stahl had omitted and *Hemidactylus brooki* which Stahl had alluded to without naming.

Del Valle names only those animals having a direct bearing on human economy which explains his motive for omitting certain minor species.

The value of republishing this extract from his pamphlet is: He is the first to mention the food habits of Puerto Rican reptiles which has been much studied of late. He is the first conservationist of the Island. He advocates letting innocent animals live for the pleasure we should receive from knowing them, if not for their inherent right to live.

The following is the title of his pamphlet:

"Los Animales Vertebrados Utiles" y "Los Dañinos a la Agricultura del País," por Francisco del Valle Atiles, Doctor en Medicina y Cirugía.

Memoria, premiada en el Certamen del Ateneo Puertorriqueño, correspondiente al año de 1885, por laudo del Jurado elegido por el Ateneo de Madrid en la Sección de Ciencias Naturales.

Puerto Rico: Imprenta del "Boletín Mercantil", Fortaleza 24 y 26. 1887.

III. REPTILES

Es la tercera clase de los animales vertebrados, de generación comúnmente ovípara, suele ser ovovivípara alguna vez; su sangre. es fría, la respiración pulmonar, y la circulación incompleta; su alimentación es casi exclusivamente animal, sus dientes parecen destinados más para retener la presa, que por lo común se tragan viva, que para masticar.

Se comprenden en esta clase especies venenosas, como las víboras, el áspid y la serpiente de cascabel, que por fortuna son desconocidas en Puerto-Rico.

Tienen los reptiles una gran resistencia vital, de modo que pueden sufrir grandes mutilaciones y aún algunos poseen la facultad de regenerar las porciones perdidas, en especial la cola. Divídense en cinco órdenes á saber:

Los QUELONIOS que están representados por:

La TORTUGA. *Chelonia viridis.*—Util por la carne y huevos.

El CAREY. *Chelonia imbricata.*—Util por su concha, huevos y carne.

El TINGLADO. *Sphargis coriacea.*—Como el anterior.*

La HICOTEA. *Emys rugosa.*—Util por su carne.

Los EMIDOSAUROS que comprenden Cocodrilos y Caimanes que afortunadamente no existen en Puerto-Rico.

Los ENALIOSAURIOS que hoy no existen en el mundo.

Los SAURIOS de los quales se conocen hoy aquí:

El *Sphaeriodactylus macrolepis.* Salamandra.—Salamanquesa.

* It is a pity that Dr. del Valle Atiles did not give definite data on this species which would have added another reptile to the Puerto Rico area. There is no definite record of this species having been taken off this Island to the present day.

El *anolis velifer.*—Camaleón.
El *anolis Gundlachi.*
El *anolis Cristatellus.*
El *anolis Stratulus.*
El *anolis pulchellus.*
El *anolis Krugii.*

Lagartijos.
Todas son útiles á la Agricultura y Horticultura, porque destruyen los insectos.

El *Ameiva Plei.*—Iguana.—Indiferente como los que siguen:
Euprepes Spilonotus.—Lúcia.
Amphisbaena caeca.—Culebra ciega.
Los OFIDIOS se conocen por:
El *Typhlops lumbricalis.*—Culebrita ciega.
El *Chilabothrus inornatus.*—Culebrón.
El *Dromicus parvifrons.*—Culebra sabanera.
El *Alsophis portoricensis.*—Culebrita.

Animales estos con los que la preocupación se ha manifestado más rebelde, debemos declararlos inocentes; de ellos el culebrón, que se come algunos huevos y viene á las habitaciones tras las aves domésticas, destruye en cambio muchísimas ratas.

IV. BATRACIOS

Animales de conformación adecuada para vivir alternativamente en el agua ó en el aire, tienen algunos respiración branquial y pulmonar á la vez en la edad adulta, mientras que la generalidad respira por branquias en la primera edad y por pulmones en la segunda. La circulación es doble é incompleta.

El aparato digestivo es corto, circunstancia que se explica por que generalmente son Zoofagos. Se alimentan de pequeños moluscos y otros animales pequeños; su reproducción es ovípara.

En Puerto-Rico se han estudiado hasta ahora:

El *Cystignathus typhonius.*—Sapo.
El *Bufo gutturosus.*—Sapo concho.
El *Hylodes martinicensis.*—Coquí.

Estos animales son útiles á la agricultura pues destruyen gran número de insectos, moluscos y caracoles nocivos á los sembrados.

Debe respetarse á estos inofensivos vertebrados que nos reportan utilidad suma.

HERPETOLOGICAL NOTES WITH NEW SPECIES FROM THE AMERICAN AND BRITISH VIRGIN ISLANDS, 1936

CHAPMAN GRANT, U. S. Army, Retired.

Army duty in Puerto Rico during 1930–32 afforded the opportunity to collect intensively on nearly all the islands from Mona at the west to Anegada at the east. Only part of a day was available at St. Croix and several islets were missed which gave me a desire to return to complete the work. The collecting netted over 7,200 specimens including 17 new species and the rediscovery, reestablishment or adding to the fauna of several more which brought the total to 77. This collection was reported in the Journal of the Department of Agriculture of Puerto Rico beginning in the July, 1931, issue.

St. Croix lies to the south and is separated by a deep channel from the Puerto Rico–Virgin Island group which lie on a shallow bank. It seemed likely that the separation denoted a great lapse of time which would have made all of the species endemic, but Barbour listed several species as common to it and the adjacent bank islands including Puerto Rico. This seemed so unnatural to me that there remained a longing to explore the island more thoroughly. Mr. T. G. Plant of the American–Hawaiian Steamship Company offered the realization of this hope by kindly furnishing transportation on the S.S. "Willboro" from Los Angeles, whence we sailed February 18, 1936, arriving at Puerto Rico March 5. Captain George Grundy and his Officers made the trip a pleasure beyond its usual interest.

On the journey it was noted that the marine snake, *Hydrus platurus* (L) did not appear as far north as it was seen in September 1930. It seems possible that more data might show a migration.

In Puerto Rico the welcome of the Lighthouse Tender, "Acacia" was again accepted which evoked the memory of pleasant trips with Captain Manyon in 1930–32. On March 14 we landed for an hour at Las Mulas, Vieques. Here we found that *Bufo marinus* had been introduced since our visit in 1931. (Jour. Dept. Agri. Puerto Rico, 16(1) 37–39). The same day we landed at Culebrita where it had not rained for fourteen months. *A. cristatellus* was plentiful. Seven *A. exsul* and 31 *S. macrolepis* were taken. A bottle was left which Mr. E. A. Murray of the "Acacia" mailed to me in Oc-

tober. It contained 3 *A. exsul,* 60 *S. macrolepis,* 1 *T. platycephalus* and 1 *Mabuya sloanii.* The last two are new records for this island. These 60 *macrolepis* added to those taken in 1931 total 91 specimens which do not include any of the red-headed *S. danforthi* which occurs across the narrow channel on Culebra. It seems strange that the red-head form should occur on Culebra and the comparatively distant Anegada and not on Culebrita. In a previous paper, (Jour. Dept. Agri., Puerto Rico. XV. pp. 205–207) it was not realized that *S. danforthi* and *S. macrolepis* occur together on Culebra. They are easily distinguished by the speckled throat of macrolepis. The speckling starts at the chin and continues to the neck where it stops abruptly. Danforthi has a clear chin and throat and the male has a red head.

The next day, March 16, we landed at Buck Island, of St. Croix where two of the plentiful *Anolis acutus* were taken. During this visit and in 1932 the writer saw no other reptile on this good sized islet. We then sailed for Christiansted, St. Croix, where the hospitality of the "Acacia" was left behind to commence the intriguing problem of:

THE HERPETOLOGY OF ST. CROIX

This expedition unfortunately coincided with a very severe drought. Ponds which no one remembered to have seen dry were expanses of cracked, baked earth. I was fortunate in meeting Mr. Harry Beatty, who is an ornithologist and is now working with the Public-Health Service on filaria control. He was born on St. Croix some thirty years ago and is a field naturalist and an artist of ability. His life of close observation made protracted collecting on my part unnecessary as he personally conducted me all over the island and gave me full benefit of the experience of his observations on the island.

Practically all of the island is in one life zone. Rolling, brush-covered hills of moderate height, a moderate amount of cactus, intermittent streams with a few trees complete an uninteresting picture. It seemed unbelievable that such a large island could be as depauperate of species as is shown by Barbour's list, but results showed that even his scanty list included several species due probably to old errors in data. The fauna is really poorer than his list shows, as the following indicates:

Bufo marinus (L)

Introduced from Puerto Rico in October 1934 at the Agricultural Experiment Station. It had spread 1½ miles east and six miles west in 1936. Under date of October 24, 1936, Mr. Beatty writes: "*B. marinus* has become well dispersed."

Eleutherodactylus lentus Cope

This species was found under rocks at the few damp places and ponds persisting on the island. Specimens taken: 1 Anguilla; 7 Criqui stream, West End; 1 Good Hope Estate; 1 Experimental farm. These averaged much smaller than the St. Thomas specimens, but larger specimens may be available in the rainy season. If not, this is truly a pigmy race.

Eleutherodactylus portoricensis? Schmidt

Mr. Beatty writes, October 24: "A Puerto Rican liberated a number of Coqui here". This species cannot yet be included in the fauna.

Leptodactylus albilabris (Gunther)

All specimens were very much smaller than those seen elsewhere. Otherwise they appear to be identical with those from St. Thomas, St. John and Tortola, which in turn are smaller, darker and less attractive than the occasional red or green marked specimens found in Puerto Rico. Specimens taken: 1 Criqui stream, West End; 6 Experimental farm; 14 Good Hope Estate. Nests were found at West End under rocks above the water line. I have never seen nests connecting with the water and it is not clear how the young get to their element.

Rana pipiens Schreber

Mr. Beatty writes Oct. 24: "Dr. Augustine of Harvard liberated 12 adults at Criqui dam". This species cannot yet be included in the fauna.

Hemidactylus mabouia (Moreau de Jonnes)

This species appeared very scarce in the dry season. Mr. Beatty had two preserved specimens. Specimens taken: 1 in the public library at Christiansted; another was seen at the old fort. He writes that he has captured several at the fort and has since (Jan. '37) sent 7 more, showing that the scarcity was due to the drought as he caught them all at the old fort at night.

Thecadactylus rapicaudus (Houthuyn)

Strangely enough Barbour does not list this species from St. Croix, altho both Stejneger and Schmidt do. Mr. Beatty gave me an alcoholic specimen and a second was given by employees of a sugar central. Mr. Beatty took me to a well where he had caught the first specimen and there we captured a second fine specimen hiding between the stones near the top. A fourth was seen by flashlight in a tamarind tree, but not secured. The natives are all familiar with these "wood slaves" and say: "They bawl like a fowl in the tamarind trees at night". The three were compared with 54 specimens in the American Museum. It was found that the St. Croix form has a row of large scales next above the upper labials, whereas all but 8 of those in the museum have the fine granules next to the upper labials. The 8 which most nearly approach the St. Croix specimens are all from Dominica. This may be another interesting "leapfrogging" of characters or the St. Croix stock may have come from Dominica. Another specimen taken in trees at night at Mount Victory Estate was received from Mr. Beatty, Jan., 1937. It agrees in squamation with the above.

Sphaerodactylus macrolepis Gunther

Distributed throughout the island in suitable localities. Specimens taken: 17 Good Hope; 16 Criqui stream, West End; 1 Protestant key; 4 Tagus point, East End; 8 West End; 11 gift of Mr. Beatty from West End. In Jan., 1937, Mr. Beatty sent 11 more from East End. It was described by Gunther (1859, Ann. Mag. Nat. Hist., (3), Vol. IV, p. 215). Excerpts from the original description follow: "Body surrounded by about forty longitudinal series of scales of rather large size. . . those of the back keeled, of the belly smooth. Trunk and tail uniform blackish brown, in younger individuals some scales with blackish tips; head grayish brown, marbled with black; jaws and throat striolated with blackish. . . . The scales of the throat are small, those of the breast and of the extremities keeled. . . . The tail is covered with smooth scales. . . . the belly is uniform dirty white, and the tail minutely dotted with blackish. Two specimens were in the collection."

Since Gunther's time various collectors have taken similar lizards from islands as far away as Mona and lumped them with this species because of a general superficial similarity. They probably believed that there was considerable individual variation. Consequently any little gecko with a similar pattern and scales of about the size borne

by *macrolepis* was considered to be of that species. My previous reports include this error. I first detected the lumping in the case of *S. grandisquamis* (Jour. Dept. Agri. P. R., Jan., 1932, pp. 43–45.)

In the light of more thorough collecting and the discovery of an easy way to determine the sexes[1] it has been found that several species have a marked sexual dichromatism and that there is not a very great individual variation in color or pattern. As a consequence, after determining the sexes it is frequently possible to allocate the specimen to a certain island purely from pattern.

The size of dorsal scales varies somewhat among the species, but Barbour's unit of measurement is to take the number of dorsals contained in the distance of snout tip to center of eye. It is believed that this measurement is too short with consequent possibility for inaccuracies. We recommend the count of a dorsal row from a point opposite the middle insertion of the front legs to a point opposite the middle of the insertion of the hind legs. This gives a range of between 18 to 28 scales for all but one species of this region.

Gunther's description of *macrolepis* is sufficiently exact to differentiate it from the other species on St. Croix. Some further characters of this species might be mentioned. The basic target pattern on the head of the male is so much broken up that the head appears to be marbled with irregular, fine broken designs of dark on gray. There is always a light stripe between the eyes. The scapular mask pattern is missing or very small; the rest of the back is an even gray-brown or contains occasional dark scales which give a dotted appearance. The chin is evenly mottled, black and white. This pattern does not stop short at the neck, but extends onto the chest and also shows occasional dark spots all over the belly and underside of legs and tail. Fig 1 A and 1 D.

The female is much like the females of adjoining islands which represent this species, but like her mate, her underside is spotted with brown. The throat does not have the even, black and white dotted pattern, but bears ill defined brown streaks which give it a dirty appearance. Fig. 1 B and 1 C. *Macrolepis* varies from island to island and will doubtless be broken down into more species or subspecies as material accumulates. On Culebra, where it occurs with danforthi, the head pattern of the male is of mottled black and white with a black occipital spot clearly indicating the target pattern of the female. Ventrally, the sharply contrasting black and white throat pattern of the male stops abruptly at the neck, the re-

[1] Grant, The Sphaerodactyls of Puerto Rico, Culebra and Mona Islands. Jour. Dept. Agri., P. R. XV. No. 3. July, 1931, p. 199, Pl. XX.

mainder of the underside being usually clear or very lightly speckled or clouded. Fig 2 A and B. The female is similar to the female on St. Croix except that the occipital black spot is more definite and the central part of the throat and the whole underside is much clearer white. Fig. 3 A and B. *S. danforthi* Grant, Fig. 2 C and D, is found on Culebra and strange to say, also on Anegada. Fig. 4. An impossible distribution perhaps but I am unable to separate the forms.

This species is best known in life by the red heads of the males. Preserved specimens can be distinguished by: males lack any head pattern except a faint occipital dark spot. The throat does not have the black and white spots. I cannot distinguish the females from the female *macrolepis*. Originally I described *danforthi* as having a dichromatic male. I would now modify this assumption by saying that the redheads were the adults and the spotted heads were immatures, except for the fact that I have not seen an intermediate on Culebra and, still more convincing, the speckled throated *macrolepis* does not occur on Anegada and the redhead form does not occur with macrolepsis on any other of the Virgin Islands. There is a puzzling form on Vieques which may be distinct or it may be a hybridization between *danforthi* and *macrolepis,* but no intermediates have been found on other islands.

While collecting on Culebra in 1932 one female *Sphaerodactyl* was taken which made me doubt that the male *danforthi* was dichromatic. I therefore went on record that the redhead form was the type of *danforthi.* A constant character of the *danforthi—macrolepis* group is that the chin and throat of the females are never conspicuously marked with black and white, but are faintly streaked with dull brown. This one female however, had conspicuous black and white throat markings and I thought it possible that she might be the only female *danforthi* taken. This specimen is larger than any other specimen taken on Culebra and the scales are larger and coarser, being 18 in length and 35 around the body. More of this material may prove interesting. Fig. 3 C and D. To return to St. Croix:

Sphaerodactylus beattyi sp. nov.

Type: Adult female, 80567, U.M.M.Z. Collector, Chapman Grant, May 17, 1936.

Habitat: Eastern end of St. Croix.

Diagnosis: An extremely slender Sphaerodactyl with finer scales than any heretofore known from this area, and a distinct change of pattern during growth.

Description of type: Adult female: about 46 dorsal scales in line between a point opposite insertion of front and hind legs and about 56 rows around the body. This is about double the number on other species in this area. Color above, dark gray without trace of scapular pattern; occasional dark scales on back and tail. An indistinct dark spot at occiput; a dark line centrally from snout to occiput. Note that this is the only species in the area with a dark stripe between the eyes. On other species the line divides before reaching the orbits, leaving a light line between the eyes. Underside clear light; indication of light "Y" on the sacrum. Fig. 5 A and B.

Variation: The male is marked identically like the female and can be told only by the escutcheon. Immature, but full grown specimens of both sexes have an elaborate pattern. A dark median line from snout to just beyond the occiput. Another dark line from snout over eye to above ear. Another dark stripe along side of face. Throat clear or mottled or sometimes clouded with minute specks which may extend along the belly. Remainder of back marbled more or less conspicuously with dark brown and gray according to age. A distinct and specific mark is a light "Y", the branches of which start on the sacrum and the stem runs onto the tail. This "Y" does not show well on the type which has a regenerated tail, but appears clearly on all the other specimens. Fig. 5 C and D. This and the central head stripe are apparently the only marks which do not disappear with age. Underside as in adults. My original collection from St. Croix contained the one adult and four immatures. Fig. 5 D.

Through the kindness of Mr. Shreve of the Museum of Comparative Zoology at Harvard the type was compared with a cotype of *S. vincenti* and found to have a less granular mid-dorsal area and different scutellation round the rostral and supranasal region and also to differ in coloration.

Twenty-six specimens examined.

Named in honor of Harry L. Beatty.

Iguana i. iguana (L)

Neither Barbour, Stejneger nor Schmidt reported this species, but Dunn reports it in Copeia 1934 No. 1. p. 1. They are known by the rural inhabitants who say they used to be plentiful in places. Mr. Beatty and Mr. Robert Nichols of the Agricultural Experiment Sta-

tion of St. Thomas killed and mounted one specimen from Tagus Point, East End which the writer saw and positively identified. Now they occur only at Tagus point in trees surrounding brackish lagoons in which they take refuge. I saw many of their characteristic foot and tail tracks on the beach sand, but did not see a specimen.

Anolis acutus Hallowell

This is the most abundant life on the island. Mr. Beatty reports taking eleven from the stomach of one mongoose. The species occurs everywhere on St. Croix, Buck Island and Protestant key. Specimens taken, 2 Buck Island, 1 Good Hope, 4 Experiment Station. A large series was taken in 1932. In January 1937 Mr. Beatty sent me 3 specimens from Green Cay near the harbor of Christiansted. This species closely resembles *A. cristatellus* in the field. Schmidt 1928 p. 26 considers it directly related to *A. poncensis* and Barbour, 1930 considers it close to *A. krugi.* The throat fan is very distinctive but unfortunately shrivels and loses color in alcohol.

The following *Anoles* do not occur on St. Croix: *Anolis cristatellus* (D. & B.), listed by Schmidt p. 151. *Anolis newtoni* Gunther, type locality "St. Croix" of which Barbour states: "I have never seen this species and know nothing about it." *Anolis pulchellus* D. & B. is listed by Barbour and Schmidt. Mr. Beatty has never seen it on St. Croix. Familiarity with the habits of this form and *A. poncensis* on Puerto Rico and a careful search leads me to believe that specimens labelled "St. Croix" are in error.

The Rediscovery of *Ameiva polops* Cope

Ameiva exsul Schmidt, 1928. N. Y. Acad. Sci. Vol. X. Pt. 1. Barbour, 1930 and 1935 Zoologica, Vols. IX p. 102 and XIX. p. 126. "I have always doubted the St. Croix record."

Ameiva riisei Reinhardt and Lutken, 1862. Vidensk. Meddel. pp. 232–233. "*A. riisei* is sent in from St. Thomas, St. Jan and Water Island, Vieques and Porto Rico."

Ameiva orstedi Bocourt, 1870. Recherches Zoo. Cent. Am. & Mex. Pl. XX. figs. 4 and 4 *a*, "St. Thomas" are clearly *A. polops,* the locality being in error.

Ameiva plei Cope, 1862, Proc. Phila. Acad. p. 65.

Ameiva polops Cope, 1862, Proc. Acad. Phila. p. 66. Reinhardt and Lutken, 1862 Vidensk. Meddel. pp. 232–233. Cat. of Lizards, Br. Mus. 1885, Vol. II p. 35. Stejneger, 1904, U.S.N.M. No. 129 p. 564. Barbour and Noble, 1915, Bul. M. C. Z., LIX. No. 6.

Schmidt, 1928 N. Y. Acad. Sci. Vol. X. p. 153 "Known only from the type from St. Croix." Barbour, 1930 and 1935 Zoologica Vols. IX. p. 102 and XIX p. 125. "Extinct, but very few specimens have been preserved."

Intensive field work with *A. exsul, A. wetmorei* and their allies gives one an understanding of the confusion quoted above. *A. exsul* varies so much with age and locality that it was natural for the pioneers to make separate species of the different pattern stages whether due to age or locality. Mr. Beatty thought that the "ground lizard" which used to occur all over the island was *A exsul* since *A. polops* was supposed to be extinct. He reported it as still extant at East End, in some empty city lots facing Christiansted harbor and on Protestant key. This key comprises about three acres suitable for *A. polops* and there is much building going on with a view to making a park out of the key The completion of this project or the introduction of a cat or mongoose would probably exterminate this interesting lizard on this key. We were unable to find any specimens except on Protestant Key where we took eight of what we estimate to be about 35 specimens. They are very wild. Mr. Beatty made an accurate color sketch of a freshly killed specimen which unfortunately cannot be reproduced for this article. There may be other specimens in museums labelled *A. exsul* etc. In a late letter dated January 15, 1937 Mr. Beatty says: "On my first visit to Green Cay in 1936 I did not see a single Ameiva during an entire morning's search. On my second visit, recently, I observed many scurrying about the beach, a large number of these being young. I dissected a few and found that they were feeding on the species of semiaquatic amphipods, very abundant among beached seaweed. Ameiva seems to have disappeared entirely from the mainland where formerly they were abundant in certain localities."

Color notes from a freshly killed specimen are given: Head, olive, a wide light olive stripe from nape to sacrum; laterally a faint light yellow line which disappears at midbody; laterally to these, a black or dark brown stripe one-third width of central stripe; laterally to these, a narrow yellow stripe from top of ear to thigh; a dark reddish brown stripe along side of body below last mentioned stripe from behind ear (width of ear) including top of thigh and extending onto tail where it disappears one third way down; below this is a narrow gray stripe from under ear to shoulder, beyond which this stripe becomes bright blue with speckled edges to groin. It misses the front of the thigh, but appears from knee to foot and behind thigh to little toe and down tail for one-third its length where it disappears. Below this stripe is a black band with uneven edges from axilla to groin and extending half the length of the tail where it disappears. Underside; chin and chest deep salmon, two and a half

rows of ventral plates from center line a dirty light blue; two and a half rows lateral to these are bright peacock blue. Tail; sides and bottom distinctly ringed along central three quarters of its length. Rings obscure along top of tail. Side of head, snout and labials, salmon; a white ring around ear.

The largest male measured; Total length 235 mm.; snout to vent, 64; snout to center of ear, 19; width of head at ears, 10; foreleg from axilla, 25; hindleg from groin, 50; tail, 171.

Amphisbaena fenestrata Cope

Listed by Barbour and Schmidt. This species has never been seen by Mr. Beatty who writes on October 24, 1936 and again on January 15, 1937 that the drought is over and that he and Dr. Seamen have watched the plowing by the Virgin Island Sugar Cane Co. of various overgrown fields without results. I turned many logs and rocks and watched plowing during my stay also without results, but the drought might have accounted for that. It is recommended that this species be dropped from the fauna of St. Croix. If an Amphisbaenan is ever discovered it will doubtless prove to be endemic. I believe its absence may be parallel to its absence on Jamaica.

Mabuya sp.

Barbour lists *M. sloanii* Daudin in 1930. In 1935 he gives *M. mabouia* as occurring "through the West Indies". Schmidt lists *M. sloanii* from St. Croix. Mr. Beatty has never seen a skink on St. Croix. If one did exist there it is probably now extinct. The evidence seems insufficient to retain this species in the fauna.

Typhlops richardii D. & B.

Barbour 1919 lists *T. lumbricalis* as occurring; in 1930 he mentions the genus as occurring, but in 1935 omits it. Schmidt lists *T. richardii.* Stejneger omits the genus.

Specimens secured: 1 Little Le Grange and 1 Anguilla, gift of Mr. Beatty; 2 West End, gift of Mr. Nichols of St. Croix; 1, Mr. Beatty, no data.

Mr. Beatty writes on October 24, 1936: "Typhlops is not uncommon at present, but certainly is very restricted in range, being confined to certain slopes in sections of the northwestern hilly portions of the island." Mrs. Gaige writes that these specimens cannot be separated from *T. richardii.*

Alsophis sanctae-crucis Cope

Mr. Beatty has not seen a specimen since he was a child, but his father and all the older generation remember them as having been plentiful. They have probably been exterminated by the mongoose here and on Buck island. It may still occur on Protestant key, but we searched for it at the optimum time, 8–10 A. M. on two occasions without result.

To recapitulate: We have only eight species which we may feel reasonably sure were pre-columbian:

Eleutherodactylus lentus Cope
Leptodactylus albilabris (Gunther)
Sphaerodactylus macrolepis Gunther
Sphaerodactylus beattyi sp. nov.
Anolis acutus Hallowell
Ameiva polops Cope
Typhlops richardii D. & B.
Alsophis sanctae-crucis Cope

Of these 5 are endemic with the possible addition of the two frogs which may be a distinct pigmy race.

Iguana i. iguana may have been introduced by the Caribs for food.

Hemidactylus mabouia and *Thecadactylus rapicaudus* may have been introduced by sailing ships in early days.

Bufo marinus is of recent introduction, but is well established. Other species have been so recently introduced that their establishment is questionable.

No St. Croix species is identical to the Puerto Rican fauna. *E. Albilabris* is much closer to the small, dark Virgin Island strain than to the larger, more vividly colored Puerto Rican form. St. Croix was apparently connected to the other Virgin Islands long after they were separated from Puerto Rico.

The next stop was St. Thomas whence two trips were made to Tortola and a few hours spent on St. John. While at St. Thomas my stay was made delightful by the kindness of Captain and Mrs. T. C. Rose of the Public Health Service. Captain Rose made the sturdy "Q-20" available for several trips to outlying islands and Mr. Robert Nichols of the Agricultural Experimental Station took me on several trips over the island in his car and accompanied me in several boat trips in the extraordinary little built-up dug-out of the "Cha-cha" fisherman, Joe Olivo. Joe's enthusiasm in collecting was a constant source of pleasure as he would spy the "next qual-

ity'', meaning another species, on the various islets we visited. His pronunciation of the constant protest against the dry weather was inimitable, ''Oh, very druoy.''

First we will list the collecting done on and about St. Thomas.

ST. THOMAS

Eleutherodactylus lentus Cope

Thirteen from a cistern at Villa Olga near sea level. They are much more yellow and larger than the specimens from St. Croix. Color note from live specimens: Sides and back of thighs dark brown and white marbled, remainder dark brown and tan in large specimens and dark brown and olive green in smaller specimens. Belly white, chin light yellow; under rear of thighs red. Three from a cistern at top of west end of island, elevation about 1,000 feet.

E. antillensis R. & L.

A number taken from banana sheaths at top west of island.

E. cochranae Grant

About 52 of this and the last preceding taken together.

Leptodactylus albilabris Gunther

Three from the Ag. Exp. Station and a number from the top west of the island. This was the only damp spot we could find in the higher parts of the island.

Hemidactylus mabouia M de J.

Three from the quarantine station. This species is common on the island.

Thecadactylus rapicaudus (Houttuyn)

Mentioned by Schmidt, but I find no trace or other record. It should be dropped from the fauna until rediscovered.

Sphaerodactylus macrolepis Gunther

Twenty-two specimens taken at quarantine station, Villa Olga, Ag. Exp. Station and top west of island. Common in suitable places.

Iguana i. iguana L

Seen mostly in city gardens in the shrubbery and near "Bluebeard's Castle". Horribly stuffed specimens are hawked by the natives.

Anolis cristatellus D. & B.

Ubiquitous. Exceeds all other species combined.

A. stratulus Cope

Collected here before, but none seen in this drought.

A. pulchellus D. & B.

Same as the last.

Ameiva exsul Cope

Very numerous around Villa Olga where they live in the crab holes coming out in mid morning and mid afternoon. Two taken. They occur throughout the town, at the quarantine station and more sparingly throughout the brush.

Amphisbaena fenestrata Cope

Neither Mr. Nichols nor I have seen this species from St. Thomas.

Mabuya sloanii Daudin

Probably extinct on St. Thomas proper, or very rare.

Typhlops richardii D. & B.

Mr. Robert Nichols presented eight which had been collected at the Agricultural Experiment Station during the last year. I found one specimen under a rock at the top of the west end of the island. It was very small and was aestivating in a hole similar to those used by aestivating Lumbricus and may well have been one whence the rightful owners had been eaten. Of this specimen Mrs. Gaige says: "It has only 20 rows and the dorsal count is somewhat low for richardii and it is short bodied for that species.

Dromicus exiguus Cope

Three from the Experiment Station presented by Mr. Nichols.

Alsophis antillensis Schlegel

Probably long extinct. Neither Mr. Nichols nor I have heard any recent reports of them.

Testudo tabulata Walbaum

A few specimens are kept in gardens or cemeteries as pets.

There follow records from the islets adjacent to St. Thomas: Buck Island (or Capella Islands as it appears on some charts. Capella is the diminutive for she-goat.)

Alsophis and Mabuya are the first reptiles to disappear from any island, whereas Ameiva is one of the most persistent. It occurs on every key or islet where there is any suitable ground or cover. Nevertheless Ameiva does not exist on these large, suitable islands and the two most likely to disappear are to be found; the skink in profusion and the snake occasionally. I have visited the islands repeatedly and have taken men and boys along for a thorough search in the optimum part of the day without finding trace of Ameiva.

A new record for this island was *S. macrolepis* of which four specimens were taken and *A. cristatellus* was very numerous. Three *M. alvanii* were taken.

The Alsophis on this island varies more from antillensis than does variegatus from portoricensis. Three specimens were taken on the northern of the two islands, being the island which bears the lighthouse.

Alsophis nicholsi sp. nov.

Holotype: No. 80648, Museum of Zoology, University of Michigan; March 15, 1936. Collector, Chapman Grant.

Habitat: Known only from the northern of the twin islands known as Buck Island or Capella Islands, off the port of St. Thomas, Virgin Islands.

Diagnosis: A pale form with the squamation of antillensis but the pattern of portoricensis, namely differing from typical antillensis in that the lateral stripe on scale rows four and five is visible only on the neck, where it is very faintly indicated, the broad dark dorsal band is likewise faint and is evidenced only by a gradual darkening of the more dorsal scales and the pattern on the eighth row is missing. The chin, throat and fore part of the body are immaculate and lack any traces of the characteristic mottling or spotting.

Description of Type: Head scutellation normal and the same as that of typical antillensis, as are other structural features. Ventrals 185, tail broken. In life the dorsal ground color is pale olive green, which fades to pale brown in alcohol. This color is light laterally, but becomes more intense dorsally. Each scale with a diffused darker margin. On the neck there is evidence of

the characteristic dark lateral band on scale rows four and five, but the characteristic marks which occur on the eighth row of antillensis are missing. The upper surface of the head is colored like the dorsum, each scale partially bordered with dark brown; the side of the head is not differentiated in color. A very narrow dark line demarks the sutures between the supralabials and the scales lying above them. The chin is almost immaculate white, with only a very few light brown mottlings. The anterior part of the belly is immaculate white; the posterior part and ventral side of the tail is white, slightly dotted with brown.

Variation: The two paratypes, No. 80640, March 5, 1936 and 80641, April 20, 1936 are essentially the same as the holotype. The ventrals are 181 and 182; the tails of both are broken; one specimen has a broken, posterior brown border on the posterior ventral and subcaudal shields. The snakes taken on surrounding islands are typical antillensis.

Dr. Stuart kindly furnished most of the above description since the specimens are at Ann Arbor and this is written in California.

Named in honor of Mr. Robert A. Nichols of the Agricultural Experiment Station, St. Thomas, Virgin Islands.

Hassel island forms the west side of St. Thomas harbor and is the type locality of *E. cochranae*. A very much spotted *A. exsul* was taken; a dead *Iguana i. i.* was seen in a disused rain catchment basin; *A. cristatellus* was abundant; no *E. cochranae* were seen probably on account of the drought, neither were any salentia seen on any of the other islets.

Water island is large and lies west of Hassel, near the "mainland" of St. Thomas and has no mongoose. One *Iguana i. i.* was shot as it jumped off a rock and started to swim into a shallow lagoon. The legs are not used in swimming, but locomotion is accomplished by a sinuous movement of body and tail. They are adept divers, being able to stay under water a considerable time. This specimen contained 22 eggs. Several others were seen in this same lagoon which was the only one left which contained water. Normally there are several filled with brackish water. Two *Alsophis antillensis* were taken. They are more plentiful here than on any island visited. *A. cristatellus, A. stratulus, A. pulchellus* and *A. exsul* were numerous. A colored charcoal burner had just captured a small *Testudo tabulata* which is found feral on this island.

Little Saba Island lies further west, about half way to the western tip of St. Thomas. Two new records were made for the island; an *Alsophis antillensis* and a *Mabuya sloanii* were taken and another skink was seen. *A. cristatellus, A. stratulus, A. exsul* and *S. macrolepis* were seen. This is a steep little islet, covered with thick grass,

a few cactus and a patch of small trees and a nice little lagoon. Adjacent are two keys known as Turtle-dove and Flat Keys, but they were not visited.

Savana Island lies near the west end of St. Thomas. It is a very steep, rocky islet covered with thatch palms; has a few goats that have eaten off all the grass, but there are no mongoose. We took a *S. macrolepis*, 2 very large *A. exsul* and 2 *Alsophis antillensis*. *A. cristatellus* was common, *A. stratulus* uncommon.

Salt Key lies off the west end of St. Thomas. A good sized islet, having diversified terrain, a lagoon, dry at this time and with all the appearances of good collecting, but *A. cristatellus* and *A. exsul* were the only species seen. West Key, lying between this and the west tip of St. Thomas was not visited.

Dutchman's Cap is a steep rock bearing a few cactus and stunted trees and its ubiquitous goats. *A. cristatellus* and *A. exsul* were the only species seen.

Cockroach Island is a steep rock furnishing seabirds with a rookery. A little dirt and coarse grass and goats complete the picture. The collecting results were better however, as the islet produced 3 *S. macrolepis* which did not look at all typical, 3 *A. cristatellus* and a dead *Alsophis antillensis* which must have been killed by the sea birds or the goats. There were no Ameivas.

Off the north shore of St. Thomas lie Inner and Outer Brass Islands. They are very rough, covered with small trees and goats and sea birds nest on the outer one. They produced only *A. cristatellus* and *A. exsul*. Pelican Key, Hans Lolick and Little Hans Lolick Islands, Grass Key and Thatch Key off the northeast of St. Thomas were not visited. The islands off the east end were reported on in 1932. They produced only *S. macrolepis, A. cristatellus, A. pulchellus, A. stratulus, A. exsul* and *Alsophis antillensis*. Frenchman's Cap, south of St. Thomas was not visited.

A few hours were spent at Cruz Bay, St. John where *A. exsul, A. stratulus* and *A. cristatellus* were taken and *Hemidactylus mabouia* was seen. At Cinnamon Bay 11 *S. macrolepis* and 2 *Eleutherodactylus portoricensis* were taken. The frog was not found at Cruz Bay in 1932, but was reported as heard from the general locality of Cinnamon Bay. (Jour. Dept. Agri., P. R., XVI. p. 340.)

Three visits of several days each were made to Tortola in the hope of securing more specimens of *Epicrates granti*, but this island was also in the grip of the drought.

The following specimens were taken on Tortola: 2 *L. albilabris*, one having the burrowing snout developed; 50 *E. antillensis*, mostly

of a uniform gray; 94 *E. portoricensis,* all having considerable red on the legs and even on the snout which was never noted on Puerto Rico. They differed also in being uniform in size and without pattern; 3 *Hemidactylus mabouia* from the east end of the island. These were found in a hut where a small necked bottle was found to have received 14 nearly spherical eggs and some hatched shells similar to *Sphaerodactyl* eggs, but much larger. They measured 8.5 × 10, 9 × 10 and 10 × 10 mm. Some hatched on the way to New York and they and the remaining eggs were given to Dr. Noble's Experimental Biological Department. The fact that these eggs do not adhere to the surface where the female deposits them lessens the possibility of fortuitous distribution in logs and other freight. 125 *S. macrolepis* were taken while *A. cristatellus*, *A. pulchellus* and *A. stratulus* were plentiful and a few were taken. *A. exsul* is fairly abundant. One *Amphisbaena fenestrata* and 6 *Dromicus exiguus* were also taken.

THE ISLANDS AND KEYS ADJACENT TO TORTOLA

Peter Island produced 4 *H. mabouia,* one of which contained eggs and several were infested with tiny red mites; *S. macrolepis, A. pulchellus, A. cristatellus* and *A. exsul* were taken as was one specimen of *Alsophis antillensis.* Dead Man's Chest is a tiny island containing cactus, trees, grass, an old ruin and goats, but should produce a good assortment. However *A. cristatellus* and *A. exsul* were the only species found. Beef Island is large and separated from Tortola by a narrow channel. It doubtless hides a respectable list, but produced only *A. cristatellus, A. stratulus* and *A. exsul.* Cooper Island showed only the two standbys. Salt Island gave 2 *H. mabouia* besides the two ubiquitous species. In 1932 I took *Alsophis antillensis* and *Mabuya* sp. on Salt Island.

Virgin Gorda is large enough to be treated separately if one might collect there in moist weather. Two trips to the island showed very good results considering the drought. One *Bufo turpis* Barbour was taken. This is a very different form from the equally rare *B. lemur* from Puerto Rico. Besides this the following were taken: 38 *S. macrolepis,* 8 *A. cristatellus,* very common, 8 *A. pulchellus,* 14 *A. exsul,* 8 *Mabuya sloanii* and 6 *Alsophis antillensis.*

THE HERPETOLOGY OF ANEGADA

Anegada is unique in structure among the islands of the Puerto Rico—Virgni Island group. Long before coming in sight of land,

the gradually sloping white bottom is visible. Small sailboats have to anchor half a mile off shore, row boats stop 200 yards from shore whence the visitor wades. The island is perfectly flat, shaped somewhat like Cuba, covered with sand or a little soil over part of the pavement—like limestone. Small thorny growth sends its roots laterally in search of holes down which they disappear like fleeing serpents. The holes are of various sizes and some as smooth and round as if bored by an augur. The island was parched at the time of my visit.

Leptodactylus albilabris Gunther

This species is listed, but it was not found in 1932 or on this trip. The natives speak of a "crapeaud" showing that it or some other frog or toad appears during damp weather.

Sphaerodactylus danforthi Grant

Abundant under dead leaves. Some males had lemon-yellow heads, others the typical orange-red heads. Thirty-nine specimens were taken.

A. cristatellus and *A. pulchellus*

The former abundant. The latter less so.

Cyclura pinguis Barbour

Two more specimens were taken one a very large male. The stomach contained whole sea-grape leaves, whole Opuntia fruit and whole wild "nutmegs". Some of the natives keep dogs to kill iguanas with which to feed the dogs. These free ranging dogs are the only menace of extinction which is imminent. Illustrations and color notes on this species appear in the Jour. Dept. Agri., P. R. XVI p. 342, 1932.

Ameiva exsul Cope

Fairly abundant. Called ground lizard.

Mabuya sloanii Daudin

Forty specimens were taken which appeared to have a constant difference in size and color from those on other islands. Mrs. Gaige writes: "The two differences you note—color and size, do seem constant in your series, but I cannot find any other differences." These specimens average 10 mm. shorter and lack the dorsal tri-marked scales so typical of the species on other islands.

I questioned the turtlers on this and other islands closely, both on this trip and in 1930–32, with entirely negative reports on *Caretta kempii*. *C. caretta* is well known as are also the green and hawksbill turtles of course.

Dromicus anegadae (Barbour)

Two small specimens were taken. One appeared to have swallowed some very large object, but it was found to contain three very large eggs in an oviduct. Mrs. Gaige kindly examined these two specimens and wrote under date of March 3, 1737: "I find the two specimens appear to be identical in scutellation and color, except that one specimen has two large scale pits and the other has only one small, obscure one. This is the only difference between Alsophis and Dromicus as at present recognized." Thus it appears that Anegada may be a point of intergradation between these two genera as at present recognized.

On my return trip, while visiting near Río Piedras, Puerto Rico I saw a large *Rana catesbeiana* crushed in the road. In 1932 I had heard of its prior introduction, but could not learn any dates. The importation was probably unofficial.

While in New York City, Mr. Carl F. Kauffeld of the American Museum, kindly allowed me to compare their fine series of *Hemidactylus mabouia* and *H. brooki* from Africa, whence the West Indian specimens are supposed to have come in slave ships, with my specimens and others from the New World. Their series of 71 specimens of *H. mabouia* from Nyassaland and 77 from the Belgian Congo was compared to New World specimens with the result that the Congo and New World forms are found to be alike, but the Nyassaland specimens are distinct as the accompanying table shows.

HEMIDACTYLUS MABOUIA (M de J)

	New World and Congo	Nyassaland
Length of adults, snout to vent	64 mm	80 mm
Femoral pores of males	16–17	25
Femoral pores interrupted at midline	No	By one scale
Dorsal tubercles	Strongly keeled, longer than wide	Not keeled, wider than long or circular
Longitudinal rows of spines at base of tail	6 strong rows of heavy spines	4 (rarely 6) weak rows of short spines

Hemidactylus brooki Gray

This species is found only on Puerto Rico proper of the Puerto Rico—Virgin Island area. It was probably not introduced from the Congo by slavers as the following table shows.

	Puerto Rico	Congo
Femoral pores interrupted at midline by....	One scale........	3 to 5 scales
Infralabials..	9.	7
Mental wider than rostral.......	No...........	Yes
Spines at sacral region and at base of tail...	Shorter........	Longer, heavier, thick set

The above table is derived from the 32 males of a large series from the Congo. It appears from the material at hand that *H. brooki* was not introduced from the Congo.

Explanation of Plates

Figure 1. *Sphaerodactylus macrolepis* from St. Croix. A. underside of male, note speckled throat not stopping abruptly at neck. Note speckled abdomen. B. Underside of female. Note marbled chin and spotted underside. C. Female. Note large scapular "mask" and target pattern on head. D. Male. Note diffused pattern on head, small scapular mask and nearly clear dorsum.

Figure 2. A. and B. male *S. macrolepis* from Culebra. Note black occipital spot on head and speckled throat with abrupt demarcation at neck and clear venter. C. and D. male *S. danforthi* from Culebra. Note unmarked head, no scapular pattern and clear chin and venter.

Figure 3. A. and B. female *S. macrolepis* from Culebra. Note target pattern on head, large scapular mask, faintly mottled chin and clear venter. C. and D. female *S. macrolepis ?* from Culebra. Note very coarse scales, striped head, and very vividly marked throat and chin.

Fig. 4. *S. danforthi* from Anegada. A. and B. Males. Note clear throat and venter, clear head, small scapular pattern and dotted dorsum and tail. C. and D. Females. Note similarity to females of *S. macrolepis* from Culebra.

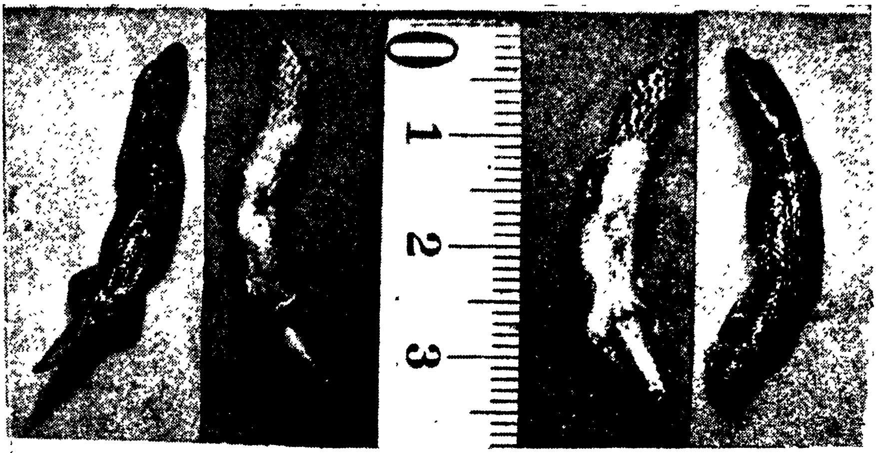
Fig. 5. *S. beattyi.* A. Type. Adult female. Note fine scales, interocular stripe and occipital dark spot. B. Adult male. Note similarity to female and light "Y" on sacrum which occurs on all specimens except type. C. Adult female. Note immaculate venter, common to both sexes. D. Immature. Both sexes similar. Note striped head and light "Y" on sacrum.

Fig. 6. *Ameva polops* Cope. After a painting by Harry Beatty.

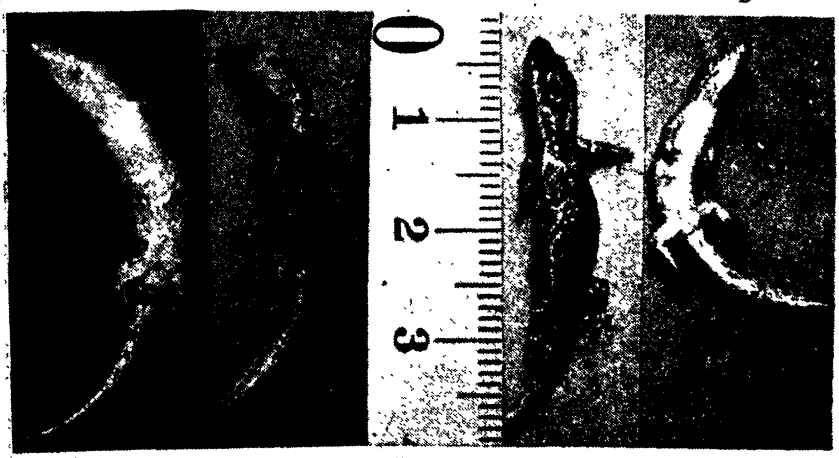
PLATE

A B Fig.1. C D

A B Fig.2. C D



A B **Fig.3.** C D

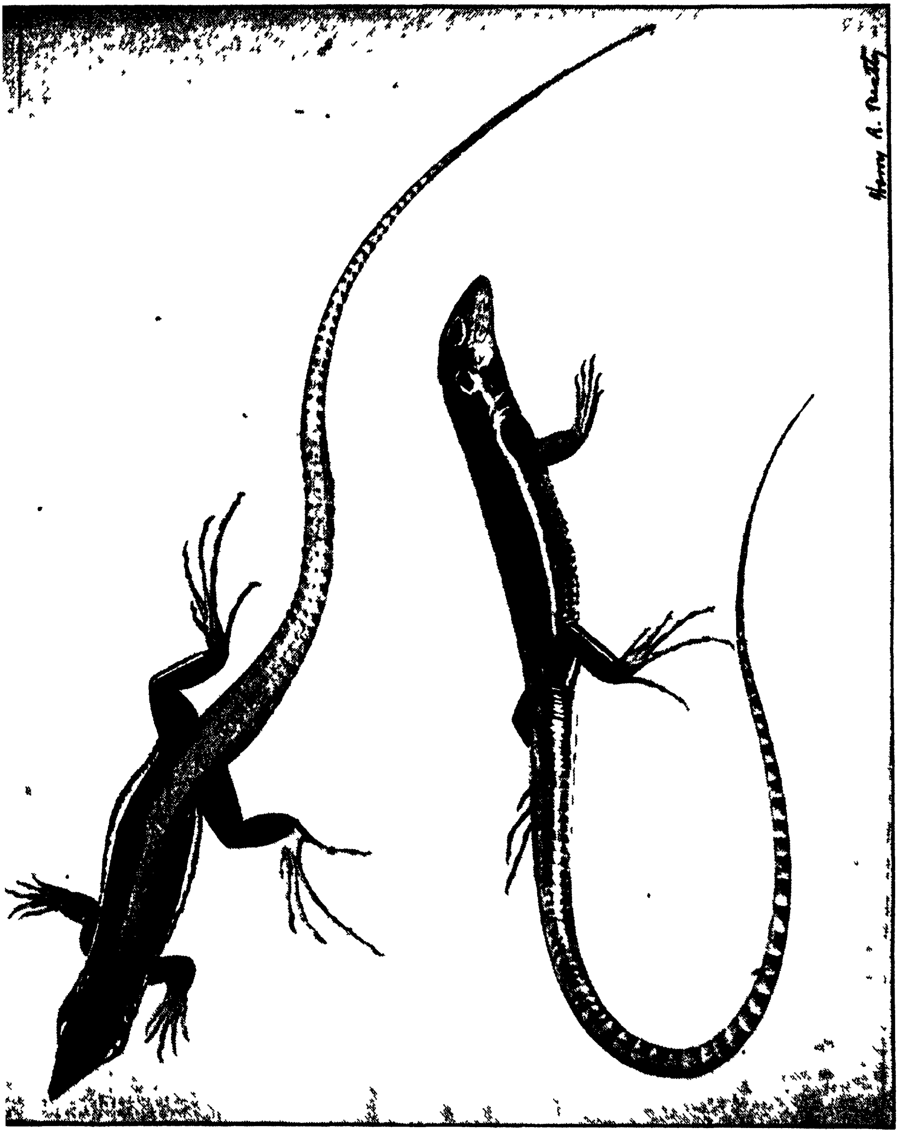


A B **Fig.4.** C D

PLATE XIV

A C B D

PLATE XV



NEW OR LITTLE-KNOWN SPECIES OF WEST INDIAN TIPULIDAE (DIPTERA). III.

By CHARLES P. ALEXANDER,
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The second part under this general title appeared in this Journal. vol. XXI, No. 2, pages 179–190. At this time I wish to discuss some unusually interesting collections taken in Oriente, Cuba, and sent to me through the continued friendly interest of Director Julián Acuña and Mr. Lawrence C. Bruner. Through the kindness of the two latter scientists, I am privileged to retain the novelties herein discussed in my collection of these flies. The specimens recorded herewith were taken chiefly on two collecting excursions to the mountainous sections of Oriente: Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner and Scaramuzza). Pico Turquino, Sierra Maestra, altitude 1650–6000 feet, in June 1936 (Julián Acuña and P. J. Darlington, Jr.). The majority of the latter were taken at light, Cueva del Aura, altitude 3750 feet, on the night of June 12, 1936.

Dolichopeza (Megistomastix) devexa sp. n.

Size large (wing, 10 mm. or more); general coloration dark brown; antennae (male) nearly as long as body, the pubescence and verticils of the flagellar segments short; wings with a brown tinge; stigma oval, dark brown; abundant trichia in cells of outer half of wing; male hypopygium with lateral portions of tergite not produced; basistyle extended into a slender, pale arm, the tip set with strong black spines.

Male.—Length about 10–11 mm.; wing 10–11 mm.; antenna 9–10 mm.

Female.—Length about 10 mm.; wing 10 mm.

Frontal prolongation of head, together with the palpi, black. Antennae (male) nearly as long as the body; scape dark brown; pedicel yellow; flagellar segments black, the more basal ones with the incisures very restrictedly pale; segments long-cylindrical, with a short erect pale pubescence; verticils relatively short and inconspicuous, about two or two and one-half times the length of the pubescence. Head grayish brown.

Mesonotal praescutum and scutum dark brown, the former with a capillary darker median vitta; posterior sclerites of notum paler brown. Pleura chiefly dark brown, the posterior sclerites and pleurotergite paler. Halteres darkened, the base of stem restrictedly paler. Legs with the coxae dark; trochanters obscure yellow; remainder of legs black, the femoral bases restrictedly obscure yellow. Wings (Fig. 1) with a brown tinge; stigma oval, dark brown; restricted dark seams on anterior cord *m-cu*; veins and macrotrichia dark. Abundant trichia in all outer cells of wing (indicated in figure by stippling).

Venation: Sc_2 ending opposite origin of *Rs*; R_{1+2} atrophied or (as figured) represented by a basal spur.

Abdominal segments obscure brownish yellow, the caudal portions of the segments darker; second tergite with a dark ring at near midlength; hypopygium chiefly pale. Male hypopygium (Fig. 9) with the caudal margin of tergite, *gt*, subtransverse or only gently convex, the lateral ends not produced into lobes. Basistyle, *b*, produced into a slender pale arm, the apex set with abundant blackened spines. Outer dististyle, *od*, elongate, strongly angulated at near midlength and here produced into a setiferous lobe. Eighth sternite with caudal margin produced into a tongue-like median lobe.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 6,000 feet, June 20, 1936 (Acuña). Allotopotype, ♀ altitude 5100–5200 feet, June 12, 1936 (Acuña). Paratopotypes, 1 ♂, altitude 6000 feet, June 12, 1936; 1 ♂, altitude 3750 feet, June 12, 1936 (Acuña).

Dolichopeza (Megistomastix) devexa is very different from the other regional species in its large size and structure of the male hypopygium. Both of the Cuban species hitherto made known are very small, whereas the present species rivals in size the largest Puerto Rican member of the subgenus discovered to this date.

Limonia (Discobola) gowdeyi Alexander.

Pico Turquino, altitude 3750 feet, June 12, 1936 (Acuña).

This species has three dark femoral rings.

Limonia (Discobola) gowdeyi Alexander.

Pico Turquino, A. Naranjo, altitude 1650 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Limonia (Limonia) caribaea Alexander.

Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Limonia (Limonia) hoffmani Alexander.

Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza). The species had not been recorded from Cuba.

Limonia (Rhipidia) schwarzi (Alexander).

Pico Turquino, Sierra Maestra, altitude 1650–3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Limonia (Dicranomyia) reticulata (Alexander).

Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Limonia (Dicranomyia) trinitatis Alexander.

Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1935 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Limonia (Geranomyia) myersiana Alexander.

Pico Turquino, Sierra Maestra, altitude 1650–3750 feet, June 12, 1936 (Acuña).

Orimarga (Diotrepha) flavicosta (Alexander).

Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

These specimens are all smaller than the type series (Blue Mountains, Jamaica) but agree in all other essentials and surely appear to be conspecific.

Epiphragma (Epiphragma) cubensis Alexander.

Pico Turquino, A. Naranjo, Sierra Maestra, altitude 1650 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza). Los Llanos, Oriente Maisi, February 5, 1929 (Acuña). Buenos Aires, Trinidad Mountains, altitude 2350–2800 feet, May 3, 1932 (Bruner & Otero).

Shannonomyia phragmophora sp. n.

General coloration dark brownish gray; halteres pale yellow throughout; legs yellow, the terminal tarsal segments darkened; wings light yellow, with a heavy brown pattern that is restricted to the vicinity of the veins; *Rs* long, connected with vein *M* by a supernumerary crossvein in cell *R*; R_2 shortly before fork of R_{3+4}; cell *1st* M_2 elongate, exceeding vein M_{1+2} beyond it; basal section of M_3 not in transverse alignment with *m*, arcuated to weakly angulated; abdomen dark brown, hypopygium brighter.

Male.—Length about 5–5.5 mm.; wing 5.5–6 mm.

Female.—Length about 6.5–7 mm.; wing 6–6.5 mm.

Rostrum and palpi black. Antennae short; basal segments yellow, the outer half of flagellum passing into brown; basal flagellar segments subglobular to short-oval, the outer segments slightly longer. Head brownish gray.

Mesonotum dark brownish gray, the praescutum somewhat clearer gray dorso-medially, the humeral portions slightly more brightened. Pleura blackish, pruinose. Halteres pale yellow throughout. Legs with the coxae dark brown, pruinose; trochanters obscure yellow; femora brownish yellow; tibiae and tarsi clearer yellow, the outer tarsal segments darkened. Wings (Fig. 2) light yellow, with a conspicuous brown pattern, as follows: Arculus; origin of *Rs* and supernumerary crossvein in cell *R*; Sc_2; cord and outer end of cell *1st* M_2; marginal spots at ends of all longitudinal veins, smallest on R_5; veins yellow, darker in the clouded areas. Venation: Sc_1 ending about opposite three-fourths the length of the long *Rs*; a supernumerary crossvein in cell *R*, connecting vein *M* with the basal portion of *Rs*; R_2 a short distance before fork of R_{3+4}; cord oblique, *r-m* much arcuated; cell *1st* M_2 unusually elongate, considerably exceeding in length vein M_{1+2} beyond it; basal section of M_3 more than twice *m*, arcuated to feebly angulated at near midlength; *m-cu* about its own length beyond fork of *M* or a little less.

Abdomen dark brown, the surface sparsely pruinose; hypopygium obscure yellow to yellowish brown.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 3750 feet, at light, June 12, 1936 (Acuña). Allotopotype, ♀ h. Paratopotypes, 12 ♂ ♀.

The present fly is very different from the two other known species of *Shannonomyia* having a supernumerary crossvein in cell *R* (*mesophragma* Alexander, *mesophragmoides* sp. n.). The elongate cell *1st* M_2, with the elements closing its outer end not lying in transverse alignment, is distinctive of the species.

The various species of *Shannonomyia* now known from Cuba may be separated by the following key:

1. A supernumerary crossvein in cell R, connecting the long *Rs* with vein *M*..2
   No supernumerary crossvein in cell *R*, *Rs* relatively short..4
2. Cell *1st* M_2 elongate, longer than any of the veins beyond it; basal section of M_3 not in transverse alignment with *m*. (Fig. 2.)
   S. phragmophora sp. n.

   Cell *1st* M_2 shorter than vein M_{1+2} beyond it; veins closing cell *1st* M_2 in approximate transverse alignment..3.
3. General coloration of mesonotum brownish yellow; wings yellowish, with a heavy brown pattern, including marginal areas at ends of veins R_3 and R_4; a dark cloud at arculus.
   S. mesophragma Alexander

   General coloration of mesonotum dark brown; wings with a weak brown tinge, restrictedly patterned with brown; marginal dark clouds sparse, small or lacking at ends of veins R_3 and R_4; no dark cloud at arculus. (Fig. 3).
   S. mesophragmoides sp. n.

4. **Wings unpatterned, except for the stigma and a darkened area at origin of *Rs*.**
S. scaramuzzai Alexander

Wings with a dark pattern, including a series of marginal clouds at ends of all longitudinal veins excepting R_5

5. **Cell R_3 very short; R_2 far before fork of R_{3+4}, the latter element exceeding vein R_3 alone; mesonotum and pleura light reddish brown. (Fig. 5).**
S. brevicula Alexander.

Cell R_3 long, R_2 lying at or close to fork of R_{2+3+4}, shortening or obliterating R_{3+4}; mesonotum and dorsal pleura dark brown. (Fig. 4.) (*bruneriana* and race).

6. **Antennae (male) very small, scarcely longer than the combined head and pronotum.** *S. bruneriana bruneriana* sp. n.

Antennae (male) larger and more powerfully constructed, if bent backward extending to shortly before wing-root.
S. bruneriana forticornis subsp. n.

Shannonomyia mesophragmoides sp. n.

Allied to *mesophragma;* general coloration of thorax and abdominal tergites dark brown; wings with a weak brown tinge, restrictedly patterned with brown; a supernumerary crossvein in cell *R;* cell *1st* M_2 of moderate length, the elements closing its outer end in transverse alignment, the cell shorter than vein M_{1+2} beyond it.

Male.—Length about 5–6.5 mm.; wing 5.5–7 mm.

Female.—Length about 6.5 mm.; wing 6.5 mm.

Rostrum and palpi black. Antennae short; scape brown; pedicel and flagellum black; flagellar segments short-oval, the verticils exceeding the segments. Head dark gray.

Thorax almost uniformly dark brown, the praescutum with a single median darker vitta; humeral region of praescutum not brightened. Halteres with stem pale, knob weakly darkened. Legs with the coxae yellowish brown to testaceous; trochanters yellow; femora brownish yellow; tibiae and tarsi dark brown. Wings (Fig. 3) with a weak brown tinge, the costal and prearcular portions a trifle more yellowish; a restricted brown pattern, including the origin of *Rs* and supernumerary crossvein in cell *R; Sc_2;* stigma; cord and outer end of cell *1st* M_2*;* very small to scarcely evident darker marginal clouds at ends of longitudinal veins, from R_3 to *2nd A,* lacking or virtually so on R_4; veins brown. Venation: *Rs* long, exceeding twice R_{2+3+4}; a supernumerary crossvein in cell *R,* connecting base of *Rs* with about the middle of *M; R_2* at or just beyond fork of R_{2+3+4}; cell *1st* M_2 of moderate length, shorter than vein M_{1+2} beyond it; elements closing outer end of cell *1st* M_2 in approximate transverse alignment, *m* shorter than the basal section of M_3; *m-cu* about two-thirds its length beyond the fork of *M.*

Abdominal tergites and subterminal sternites dark brown; basal sternites obscure yellow; hypopygium yellowish brown.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 3750 feet, at light, June, 1936 (Acuña). Allotopotype, ♀, pinned with type. Paratopotypes, 5 ♂ ♂.

The relationship of the present fly with *Shannonomyia mesophragma* Alexander is best shown by the key given with the account of the preceding species.

Shannonomyia bruneriana sp. n.

General coloration dark grayish brown, the pretergites conspicuous, clear silvery-white; halteres pale, the knobs weakly darkened; wings yellowish gray, with a relatively heavy brown pattern; *Rs* of moderate length; R_2 at or shortly before fork of R_{3+4}; cell *1st* M_2 shorter than vein M_{1+2} beyond it, the elements closing its outer end in transverse alignment.

Male.—Length about 4.8–5 mm.; wing 5–5.3 mm.

Female.—Length about 5.8–6 mm.; wing 5.8–6 mm.

Rostrum dark brown; palpi black. Antennae with scape and pedicel light yellow; flagellum black; antennae relatively small, in the male scarcely longer than the combined head and pronotum. Head ashy gray.

Pronotum ashy gray. Mesonotum dark grayish brown; pretergites clear silvery-white, conspicuous. Pleura dark brown, the sternopleurite paler. Halteres pale, the knobs weakly darkened. Legs with the fore coxae darker than the others; trochanters yellow; legs yellow, the terminal tarsal segments darker. Wings (Fig. 4) yellowish gray, the prearcular and costal regions clearer yellow; a relatively heavy brown pattern, distributed as follows: Arculus; origin of *Rs*; Sc_2; stigma; cord and outer end of cell *1st* M_2; a marginal series of spots on all longitudinal veins with the exception of R_5, largest on R_4 and *2nd A*; veins pale, darker in the clouded areas. Venation: Sc_1 ending about opposite three-fourths the length of the relatively short *Rs*; R_2 at or shortly before fork of R_{3+4}; tip of vein R_4 rather strongly upcurved; *r-m* moderately to strongly arcuated; cell *1st* M_2 shorter than vein M_{1+2} beyond it, the elements closing its outer end in transverse alignment; *m-cu* some distance beyond fork of *M*.

Abdomen dark brown; hypopygium paler brown.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 3750 feet, at light, June 12, 1936 (Acuña). Allotopotype, ♀, pinned with type. Paratopotypes, 10 ♂ ♀.

Shannonomyia bruneriana forticornis sub sp. n.

Characters as in the typical form, differing in the nature of the antennae, which in the male sex are larger and more powerfully constructed than in the typical form, if bent backward extending to shortly before the wing-root.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 6000 feet, June 17, 1936 (Acuña). Allotopotype, ♀. Paratopotype, 8 ♂ ♀, with the type; 1 ♂, altitude 3750 feet, June 12, 1936 (Acuña).

I take great pleasure in naming this interesting new *Shannonomyia* in honor of Mr. Stephen C. Bruner, to whom I am indebted for much friendly co-operation in studying the Tipulidae of Cuba. The relation of *bruneriana* and its high-altitude form, *forticornis*, is indicated in the key provided with the description of *Shannonomyia phragmophora* sp. n.

Hexatoma (Eriocera) juliana sp. n.

Size large (wing, female, 17.5 mm.); thorax and abdomen orange, the sixth abdominal segment blackened; head dull black; legs and halteres black, the bases of the fore femora restrictedly yellow; wings whitish subhyaline, heavily patterned with dark brown, including a broad margin that almost encircles the wing, together with broad, entire, transverse seams at level of origin of *Rs*, cord and outer end of cell *1st* M_2; basal section of vein R_5 longer than *r-m;* veins issuing from cell *1st* M_2 relatively short, vein M_3 being about as long as the cell.

Female.—Length about 19 mm.; wing 17.5 mm.

Rostrum black, sparsely gray pruinose; palpi black. Antennae black throughout, 9-segmented; flagellar segments two and three subequal in length, succeeding segments gradually decreasing in length; terminal segment about a fifth longer than the penultimate. Head dull black, very sparsely pruinose; a small tubercle immediately behind each antennal fossa; median vertical tubercle small and very poorly developed.

Thorax entirely fiery orange, unmarked except for a more brownish suffusion and weak pruinosity on the outer half of the mesonotal scutellum. Halteres black throughout. Legs with the coxae and trochanters orange; remainder of legs black, the fore femora with nearly the basal fourth yellow. Wings (Fig. 6) with the ground-color whitish subhyaline, heavily patterned with dark brown, so as to leave extensive fenestrate areas of the ground before origin of *Rs*, before and beyond the cord; additional areas of the ground in outer end of cell *Cu* and involving most of cell *1st A;* posterior border of cell *2nd A* narrowly grayish; the brown pattern includes the prearcular and costal borders, the latter continued almost around the wing-margin to the end of vein *2nd A,* thence as a seam the length of the latter vein; broad dark seams beyond arculus, at level of origin of *Rs,* along cord and on outer end of cell *1st* M_2; all veins dark-colored, seamed with brown, very narrowly and insensibly so in the interspaces. All longitudinal veins beyond cord with abundant, complete series of trichia. Venation: Basal section of vein R_5 longer than *r-m;* R_2 just beyond fork of R_{2+3+4}, the latter a little longer than R_3 but shorter than R_4; veins issuing from cell *1st* M_2 relatively short, vein M_3 about as long as the cell, M_4 much shorter; *m-cu* a little more than one-third its length beyond the fork of *M.*

Abdomen fiery orange, the sixth segment blackened excepting the restricted margins; genital segment orange; cerci elongate, horn-yellow, except for the darkened basal portion.

Habitat.—Cuba (Oriente).

Holotype, ♀, Pico Turquino, Sierra Maestra, altitude 5100–5200 feet, June 12, 1936 (Acuña).

Allotopotype, ♂, Pico Turquino, north side, altitude 4500–6000 feet, June 18–20, 1936 (Darlington). Paratopotypes, 1 ♂, 1 ♀, with the allotype; Museum of Comparative Zoölogy, Cambridge.

This striking species of crane-fly is named in honor of the collector, Director Julián Acuña, of the Estación Experimental Agronómica, Santiago de las Vegas, Cuba, to whom I express my sincere thanks for numerous specimens of Cuban Tipulidae. The only regional species that at all resembles the present fly is *Hexatoma (Eriocera) cubensis* Alexander, which is much smaller and has the wing-pattern and venation quite distinct, the veins beyond cell *1st* M_2 being much longer than the cell.

Atarba (Atarba) angustipennis Alexander.

Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Teucholabis (Teucholabis) bruneri Alexander.

Pico Turquino, Sierra Maestra, altitude 3750 feet, at light, June 12, 1936 (Acuña).

Teucholabis (Teucholabis) myersi Alexander.

Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

Teucholabis (Teucholabis) oteroi Alexander.

One male, Loma de Cunagua, June 24, 1936 (B. T. Barreto & L. C. Scaramuzza). The median dark annulus is clearly defined on the fore and middle femora but is lacking or nearly so on the posterior legs.

Gnophomyia (Gnophomyia) darlingtoni sp. n.

Belongs to the *luctuosa* group; allied to *flagrans;* size relatively small (wing, male, 6 mm.); head black, sparsely pruinose; rostrum, palpi, antennae, halteres and legs black; thorax fiery orange, unmarked; wings with a strong

blackish tinge, relatively narrow; R_2 just before fork of R_{2+3+4}, R_{2+3} thus being preserved as a short element; abdomen black; male hypopygium with the basistyle narrowed and produced at apex.

Male.—Length about 5.5 mm.; wing 6 mm.

Female.—Length about 8 mm.; wing 7 mm.

Rostrum and palpi black. Antennae black throughout; basal flagellar segments short-oval, the outer ones a little more elongate; verticils dense, longer than the segments. Head black, sparsely gray pruinose.

Prothorax and mesothorax entirely fiery orange, unmarked. Halteres black. Legs with the coxae orange-yellow; trochanters more brownish yellow; remainder of legs black. Wings (Fig. 7) relatively narrow, strongly tinged with blackish; posterior cells of wing from *M* to caudal margin paler in color; veins and trichia black. Abundant coarse macrotrichia in outer cells of wing (indicated in figure by stippling). Venation: Sc_1 ending just beyond the fork of *Rs*, Sc_2 a short distance from its tip; R_2 just beyond fork of R_{2+3+4}, R_{2+3} thus being present but very short to punctiform; *m-cu* shortly beyond the fork of *M*.

Abdomen in both sexes black throughout. Male hypopygium (Fig. 10) with the basistyle, *b*, narrowed at tip, the apex produced into a flattened yellow obtuse lobe, its inner or mesal edge with a linear series of about six spinous setae; remainder of apical lobe glabrous but the darkened portion of style with abundant setae. Outer dististyle, *od*, gently curved, the apex narrow. Inner dististyle, *id*, more or less clavate, provided with setae and short spines. Phallosome, *p*, broadly depressed.

Habitat.—Cuba (Oriente).

Holotype, ♂, Pico Turquino, Sierra Maestra, altitude 3750 feet, at light, June 12, 1936 (Acuña). Allotopotype, ♀.

At the suggestion of Director Acuña, I take pleasure in naming this interesting species in honor of Dr. P. J. Darlington, Jr. The nearest ally is *Gnophomyia (Gnophomyia) flagrans* Alexander (Costa Rica), which has much the same coloration. The latter fly is larger and bulkier, with broader wings and with the venational details distinct, having R_2 before the fork of R_{3+4}.

Gonomyia (Progonomyia) bifasciolata sp. n.

Antennae weakly bicolorous, the flagellar segments brownish black, their proximal ends yellow; mesonotal praescutum with three polished black areas; legs yellow, the tips of the tibiae and the outer tarsal segments darkened; wings pale yellow, with two pale brown crossbands; Sc_1 ending shortly before fork of *Rs;* male hypopygium with the basistyle produced at tip into a powerful, gently curved spine.

Male.—Length about 5 mm.; wing 5 mm.

Female.—Length about 8 mm.; wing 6.2 mm.

Rostrum brownish black; palpi black. Antennae with scape and pedicel light yellow; flagellar segments bicolorous, brownish black to black, with the proximal ends of the segments narrowly yellow, on the outer segments becoming

uniformly darkened; flagellar segments passing through oval, long-oval to cylindrical; segments (male) with a dense white pubescence and relatively short verticils; in the female, the verticils are relatively longer, exceeding the pubescence. Head light yellow to brownish yellow.

Pronotum and lateral pretergites clear light yellow. Mesonotal praescutum with the ground-color obscure yellow, with polished black areas on the cephalic portion of the otherwise brown median stripe, and with broad lateral areas that nearly reach the margins of the sclerite; scutum blackened, the median area a little paler and more pruinose; scutellum brown, darker medially at base; mediotergite blackened, sparsely pruinose, pale laterally; pleurotergite pale on dorsal half, more blackened ventrally. Pleura yellow, with a more blackened, pruinose area on anepisternum, and a reddish brown pruinose area on ventral sternopleurite. In the female, the dorsal area is more continuous behind, involving the dorsal pteropleurite. Halteres obscure brownish yellow, the knobs darker, with yellow apices. Legs with the fore coxae darkened, the remaining coxae reddish yellow; trochanters yellow; femora and tibiae yellow, the tips of the latter narrowly but conspicuously dark brown; tarsi yellow, the basitarsi darker apically; remaining tarsal segments brown. Wings (Fig. 8) pale yellow, with two pale brown crossbands, the more basal lying before origin of *Rs*, extending from cell *R* to posterior margin in outer end of cell *2nd A*; second band at cord, completely traversing the wing, darker in the stigmal field; veins chiefly pale, darker in the clouded areas. Venation: *Sc* relatively long, Sc_1 ending shortly before fork of *Rs*, Sc_2 at near mid-distance between origin of *Rs* and tip of Sc_1; R_{2+3+4} shorter than R_{1+2}, the latter subequal to R_{3+4}; cell *2nd* M_2 about one-third longer than its petiole; *m-cu* shortly beyond fork of *M*.

Abdominal tergites of male brown, variegated by paler areas, the sternites more uniformly yellow; in the female, the abdomen more uniformly blackened; hypopygium pale yellow. Male hypopygium with the basistyle produced into a powerful, gentle curved spine. Outer dististyle a flattened, nearly hyaline blade, the margin near apex weakly toothed.

Habitat.—Cuba, Panama, Mexico.

Holotype, ♂, Potrerillos, Chiriqui, Panama, altitude 3500 feet, May 12, 1934 (D. V. Brown). Allotype, ♀, A. Naranjo, Pico Turquino, Sierra Maestra, Oriente, Cuba, altitude 1650 feet, June 12, 1936 (Acuña).

Paratypes, numerous ♂ ♀, Vergel, Chiapas, Mexico, May 18–June 25, 1935, altitude 800–1200 meters (Damf) Nos. 4192, 4193, 4203, 4207, 4239, 4259, 4260, 4267, 4268, 4320, 4321, 4350, 4353, 4398, 4416, 4430, 4503 and 4641; ♂ ♀, Escuintla, Chiapas, altitude 80 meters, November 11, 1930 (Damf), No. 1814; El Zapote, Chiapas, altitude 450 meters, November 15, 1930 (Damf), No. 1867; Santa Isabel, Chiapas, altitude 800 meters, November 16, 1930 (Damf), Nos. 1879, 1880, 1881; Esmeralda, Chiapas, altitude 500 meters, November 18, 1930 (Damf), No. 1924.

Gonomyia (Progonomyia) bifasciolata is entirely distinct from the other described species of the subgenus, differing especially in the bicolorous antennae, bifasciate wings, and the structure of the male hypopygium, especially of the basistyles.

Erioptera (Mesocyphona) subdulcis sp. n.

Belong to the *dulcis* group; general coloration dark brown; legs yellow, the femora with a narrow, scarcely evident, subterminal, brown ring; wings dark brown, handsomely patterned with whitish areas, including a series of marginal spots at ends of longitudinal veins, and a nearly transverse and parallel-sided white crossband at cord.

Female.—Length about 3.5 mm.; wing 3.6 mm.

Rostrum and palpi black. Antennae black throughout; flagellar verticils elongate. Head chiefly dark brown.

Pronotum brownish black. Mesonotal praescutum dark brown, indistinctly striped longitudinally with brownish yellow; posterior sclerites of mesonotum more uniformly darkened. Pleura black, with a dirty white longitudinal stripe, extending from behind the fore coxae to the base of abdomen, passing around the base of halteres. Halteres pale, the knobs dark brown. Legs with the coxae brownish black; trochanters obscure yellow; femora yellow, with a paler brown to yellowish brown subterminal ring that is very poorly evident; remainder of legs yellow. Wings dark brown, handsomely patterned with whitish areas that are confined to the vicinity of the veins; costal area slightly more yellowish; white areas arranged as follows: Arculus; origin of *Rs; Sc_2* and fork of M_{3+4}; a nearly transverse band at cord, extending from costa to vein *Cu*, almost parallel-sided; large, conspicuous white areas at ends of all longitudinal veins excepting R_5, largest on R_{1+2} and R_3; veins pale brown, pale yellow where traversing the white areas. Venation: Elements of cord in almost transverse alignment, as shown by the white crossband that lies along the cord.

Abdomen dark brown, not or scarcely variegated by brighter.

Habitat.—Cuba (Oriente).

Holotype, ♀, Pico Turquino, Sierra Maestra, altitude 5100–5200 feet, June 12, 1936 (Acuña).

Erioptera (Mesocyphona) subdulcis is generally similar to certain regional members of the *dulcis* group, differing especially in the scarcely evident femoral rings and in the nature of the wing-pattern, especially the conspicuous white band at the cord.

Taxorhina (Taxorhina) violaceipennis Alexander.

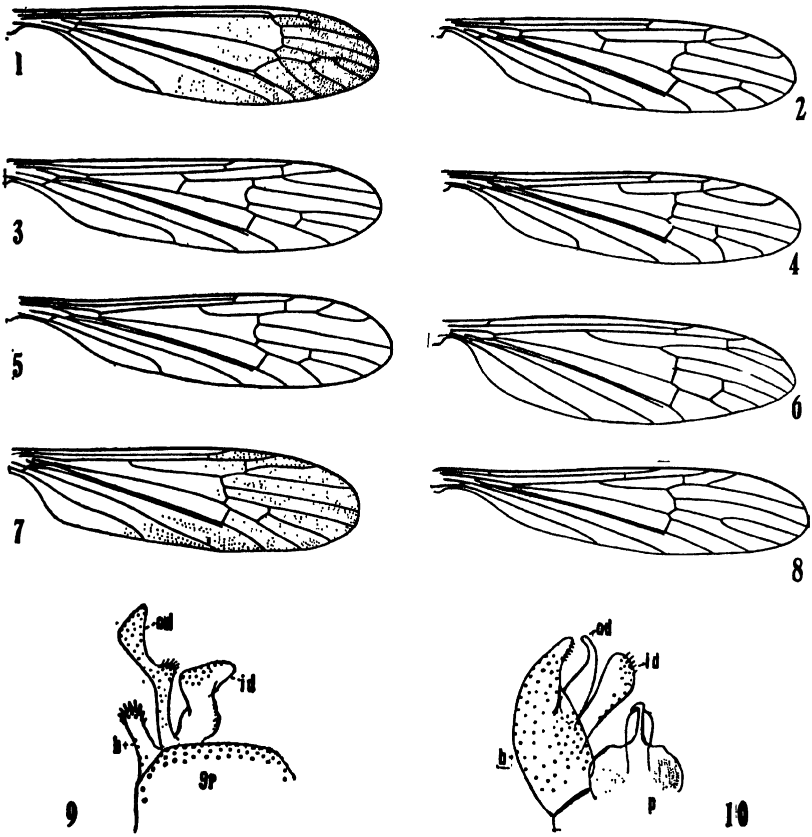
Pico Turquino, Sierra Maestra, altitude 3750 feet, June 12, 1936 (Acuña). Loma del Gato, Sierra del Cobre, altitude 2600–3325 feet, September 25–30, 1935 (Acuña, Bruner & Scaramuzza).

EXPLANATION OF FIGURES

(Symbols: Male hypopygium,—*b*, basistyle; *id*, inner dististyle; *od*, outer dististyle; *p*, phallosome; *t*, tergite.)

Fig. 1.—*Dolichopeza (Megistomastix) devexa* sp. n., venation.
Fig. 2.—*Shannonomyia phragmophora* sp. n., venation.
Fig. 3.—*Shannonomyia mesophragmoides* sp. n., venation.
Fig. 4.—*Shannonomyia bruneriana* sp. n., venation.
Fig. 5.—*Shannonomyia brevicula* Alexander, venation.
Fig. 6.—*Hexatoma (Eriocera) juliana* sp. n., venation.
Fig. 7.—*Gnophomyia (Gnophomyia) darlingtoni* sp. n., venation.
Fig. 8.—*Gonomyia (Progonomyia) bifasciolata* sp. n., venation.
Fig. 9.—*Dolichopeza (Megistomastix) devexa* sp. n., male hypopygium.
Fig. 10.—*Gnophomyia (Gnophomyia) darlingtoni* sp. n., male hypopygium.

PLATE XVI



TWO INSECTS NEW TO PUERTO RICO: THE LYCID BEETLE, *THONALMUS CHEVROLATI* BOURGEOIS, AND THE EPHYDRID FLY, *EPHYDRA GRACILIS* PACKARD

By George N. Wolcott, *Entomologist*
and
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Most of the insect pests attacking agricultural crops are not native to the country in which they do the most damage, but have been accidentally introduced from some other country. They do comparatively little damage in the country where they are native, and for the most part escape observation. But once accidentally introduced into some other country with a similar climate, where they are free from the attack of parasites, predators and other enemies which held them in check at home, they often become tremendously abundant and develop into serious economic pests. Of most of the insect pests we have detailed accounts of when and how they spread to other countries. It is the purpose of this paper to note comparable introductions into Puerto Rico of insects of minor or no economic importance.

It is not suggested that any of these insects are now, or are likely to become injurious pests, but the apparent ease with which they have overcome transportation difficulties and a very efficient and strict quarantine inspection, indicates that seriously injurious insect pests may find no greater difficulty in evading the barriers we raise against them.

The beautiful red and blue Lycid beetle, *Thonalmus chevrolati* Bourgeois, native of the Island of Hispaniola, was first recorded from Puerto Rico by Mr. R. H. Van Zwaluwenburg in his typewritten "Preliminary Check-List of Porto Rican Insects", in 1914, the determination of his specimens having been made either by Dr. Schwarz or Mr. Barber of the U. S. National Museum. Messrs. Leng & Mutchler, in their paper on "The Lycidae, Lampyridae and Cantharidae of the West Indies", published in 1922, noted that the species was "present in Porto Rico, by commercial introduction only,------ at Guánica, April in boat-load of cane from Higüeral", and in a recent letter, Mr. Van Zwaluwenburg states that in this note they were quite correct, but at this late date he can not remember whether the beetles were alive or dead when picked up in the hold of the

boat. Recent collections of considerable numbers of these beetles alive and active in cane fields, not only at Guánica, and in the nearby haciendas of María Antonia and Santa Rita, but also at Yauco, and more recently at Guayanilla, indicate that this insect is now unquestionably established in Puerto Rico. Guayanilla is over ten miles from Ensenada, the port of Guánica, at which cane boats from Higüeral, Dominican Republic, land their cane. It seems most unlikely that casual beetles would fly that distance from the cane boat against the wind in such numbers as to be repeatedly observed in cane fields and, at the time the observations were made, no cane boat was daily making the trip across the Mona Passage. It should be especially noted that the holds of all boats bringing cane from Santo Domingo to Guánica are fumigated with sulfur at the time the boat leaves La Romana, primarily to prevent the introduction from Santo Domingo of the cane butterfly, *Calisto pulchella* Lathy. This pest, of which the caterpillars often completely defoliate mature or nearly mature cane, occurs only in Hispaniola, and due to the fumigation of the cane brought from there, has not appeared in Puerto Rico. The effectiveness of burning sulfur in killing all stages of *Calisto* butterflies present on the cane is apparently not equalled in killing *Thonalmus* beetles accidentally and incidentally present on the cane, or the beetles may have used some other means of transportation to Puerto Rico.

The successful establishment of *Thonalmus chevrolati*, unanticipated and unpremeditated, in the southwestern corner of Puerto Rico is an interesting parallel to other introductions into Puerto Rico. A few miles to the west of Ensenada (towards Cabo Rojo lighthouse) is a series of salt lagoons where salt is evaporated from sea-water during the months of the year when there is no rainfall in this region. Great swarms of Ephydrid flies now occur at the margins of the lagoons, and the larvae and pupae are present in great numbers in the concentrated salt water. Material submitted to the U. S. National Museum has recently been identified by Mr. David G. Hall as *Ephydia gracilis* Packard. "This species was originally described from Salt Lake, Utah, and there are specimens in the collection from that locality, as well as from Yuma, Arizona, from San Carlos Bay, Gulf of California, and from Laguna Beach, California. Minor differences in color between the Puerto Rican specimens and those from the continent have been noted by Mr. Hall, but he found the male genitalia to match exactly and believes that only a single species is involved." (Latter of Mr. C. F. W. Muesebeck in charge Division of Insect Identification of the U. S. National Museum.)

Specimens of what is presumably the same species had been collected in this region, at Ensenada and Faro de Cabo Rojo, as far as back as 1926 by Dr. Stuart T. Danforth, but Dr. Aldrich and Mr. Curran had identified his material only to the genus. When *Ephydra gracilis* appeared here is uncertain, but Mr. Van Zwaluwenburg did not collect it at the time he was in Puerto Rico, and the great swarms of flies are so noticeable that it is hardly likely that it would not have been noted if present at that time. That any stage of this Ephydrid fly could he carried from California to Puerto Rico accidentally in such numbers as to ensure its establishment seems most improbable, yet Dr. Aldrich notes that it originally occurred in Salt Lake, Utah, and arrived in the San Francisco Bay region only after the construction of the railroad from Utah.

The traffic in insects between California and Puerto Rico is not all in one direction, however. The corn leafhopper, *Cicadula maidis* DeLong & Wolcott, described originally from Puerto Rican material collected as far as back in 1912, and from Haina, Santo Domingo in 1920, was noted in "Insect Pest Survey", p. 284, 1934, by Mr. D. B. Mackie from California as "first taken in 1933 in San Bernardino, and in 1934 attacking corn in Los Angeles County. These constitute the first record for the United States. A survey of California shows that the species is present in the eight southern counties from Kern and Santa Barbara to the Mexican border".

The turkey vulture was an intentional introduction in the Guánica region and Dr. Alex. Wetmore writes in "Birds of Porto Rico", "In the dry limestone hills above Guánica, the turkey vulture, *Cathartes aura aura* (Linnaeus), was fairly common. It appeared to range casually from Añasco to Yauco, keeping near the coast, though once reported from the summit of "Mata de Plátano" above Adjuntas. The species is said to have been introduced from Cuba into the southestern part of the Island by the Spanish Government (some say, incorrectly, by Guánica Central), the exact date not being known. An old man near Yauco who had known them since boyhood stated that their numbers had neither increased nor decreased in that time. There is no apparent reason for their not having increased and spread at least the entire length of the dry south coast, as the conditions there are apparently as favorable as in this region."

The sowthwestern corner of Puerto Rico may present unique climatic conditions, altho they would appear to be quite similar to those of comparative sections of the larger of the Greater Antilles, and most nearly like those of southern Hispaniola. Yet for each

organism which may be introduced, some special factor or factors, specific for that particular organism, apparently determines its survival. In an attempt to lessen the numbers of horn-fly in the Guánica region, Mr. G. B. Merril brought about a hundred specimens of the common dung-rolling beetle, *Canthon violaceas* Olivier, from La Romana, R. D. in 1913, and successfully reared many times that number in captivity at Hacienda Santa Rita, Guánica, releasing a hundred or more at a time when they appeared crowded in the rearing cages. Since that time, not a single individual has ever been recovered in the field. One can only wonder why, for all essential conditions appeared to be suitable for the establishment of this scarab beetle.

Of the instances cited, no two are exactly parallel, but they furnish pertinent examples of how little it is possible to predict in advance whether any particular species will become established in a new environment, even tho to us it seems very similar to that in which the species is endemic. Altho all of the species mentioned are of but minor economic importance, they also indicate the value of the most rigorous enforcement against injurious insects of plant quarantine regulations, even those which may seem at times most tiresome and oppressive. The recent appearence and rapid and destructive spread of the cotton boll wevil, *Anthonomus grandis* Boheman, in Haiti, (see this Journal 21: 69–76, 1937) apparently accidentally introduced in cargo from the southern United States, is only the most recent example in the West Indies of how easily the the most dangerous insect pests become widely dispersed under present conditions of commerce.

If it is possible for the two insects here noted to be introduced into Puerto Rico, it is possible for others to be introduced and the next insects that come to the island may be very destructive The Santo Domingo cane butterfly (*Calisto pulchella*) in all probability, would be, a very injurious pest on our most important crop, and the introduction of the cotton boll weevil (*Anthonomus grandis*) would be a great blow to our cotton industry. Both of these very destructive insects are in Hispaniola and every possible precaution should be taken to prevent their introduction into Puerto Rico.

ORNITHOLOGICAL INVESTIGATIONS IN VIEQUES ISLAND, PUERTO RICO, DURING DECEMBER, 1935

By Stuart T. Danforth,

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Accompanied by Mr. Virgilio Biaggi, Jr., as assistant, the author spent the latter part of December, 1935, in Vieques conducting ornithological investigations. We arrived in the late afternoon of December 23, 1935, and left early in the morning of January 1, 1936. During our stay we visited many localities in the island from Punta Salina on the east to Punta Arena on the west, using an old Ford for transportation which managed to get us into all corners of the island, many times over brush-grown trails where cars had never before seen. By this means we were enabled to cover a much greater portion of the island in the time available than would have been possible by the ordinary means of horseback transportation.

Vieques is an island eighteen miles long and less than four miles in width, situated east of Puerto Rico, the nearest points of the two islands being only six miles apart. Politically the island is considered as a municipality of Puerto Rico. The surface of the island consists for the most part of low hills, which are mostly planted with sugar can on the western half of the island, and covered with a xerophytic or semi-xerophytic growth of woods and brushy vegetation on the eastern half. Birds were much more abundant in the latter region, so we spent most of our time there. A number of salt and brackish lagoons occur in various parts of the island. The largest one is a very extensive mangrove-fringed pond at Playa Grande on the south coast. In the vicinity of Punta Arena there are extensive lagoons and mangrove swamps, and smaller ones exist in many other parts of the island.

During our visit 71 specimens representing 31 species were collected, and notes were made on 23 additional species. Ten species, indicated by an asterisk (*) in the systematic account which follows, had not previously been recorded from the island. The weights of all specimens obtained were recorded, and their stomachs were examined in an effort to determine something of their food habits and economic importance.

A brief description of the principal collecting localities is appended.

Campaña: A locality on the north coast about five miles east of Isabel II, approximately where cultivation ceases and the wild, brush-grown eastern part of the island begins.

Cayo Verdiales: A broad peninsula on the south coast, marked on some maps as Puerto Ferro, but the tiny settlement known as Puerto Ferro is somewhat to the east of its base. This peninsula, (for some inexplicable reason known locally as a "cayo"), is overgrown with xerophytic brush, and there is a lighthouse near its tip. Near its base are mangrove swamps and grassy fields.

Ensenada Honda: The region near a bay in the southeast part of the island is known by this name. It is mainly a region of dense, brushy hills, but in places these have been partially cleared for raising cattle, and near the coast there are some mangrove swamps, lowland woods, and tangled lowland vegetation.

Isabel II: The principal town and port of the island, situated on the north coast aproximately midway between the eastern and western extremities of the island.

Mosquito: A point on the north coast approximately midway between Isabel II and Punta Arena. It is in the center of the cultivated region.

Playa Grande: Point on the coast in the southwest part of the island where the only remaining sugar factory on the island is located. Near it is an extensive brackish water lagoon, fringed in large part by mangroves.

Puerto Diablo: Point on the north coast of the island in the wild eastern quarter of the island. Most of the hills in the vicinity are covered with xerophytic woods and brush; near the coast are some small mangrove-bordered lagoons.

Puerto Negro: Point on the north coast about half way between Isabel II and the eastern end of the island. The country is very similar to that around Puerto Diablo.

Punta Arena: The western tip of the island, closest to Puerto Rico. In its vicinity are extensive lagoons and mangrove swamps. A short distance southeast of it rises Mt. Pirata (981 feet), the highest point of land on the island.

Punta Salina: A low-lying xerophytic region near the eastern tip of the island. Two brackish lagoons, dry at the time of our visit, occur there. The hills just west of this region are very wild and covered with dry brushy vegetation.

Annotated List

* 1. *Podilymbus podiceps antillarum* Bangs
Antillean Grebe

Two observed on the lagoon at Playa Grande on December 25, 1935, constitute the first definite record of this species for the island.

2. *Pelecanus occidentalis occidentalis* Linnaeus
West Indian Brown Pelican

Fairly common along the coasts. Observed at Playa Grande, Isabel II, Campaña, Puerto Negro, Punta Salina, and Cayo Verdiales.

* 2. *Ardea herodias herodias* Linnaeus
Great Blue Heron

One was observed at Punta Arena December 24, and another at Playa Grande December 25. Not previously recorded from the island.

4. *Leucophoyx thula thula* (Molina)
Snowy Egret

Thirty were recorded at the lagoon at Playa Grande on December 25.

* 5. *Hydranassa tricolor ruficollis* (Gosse)
Louisiana Heron

Ten were observed at the lagoon at Playa Grande on December 25, constituting the first record for the island.

6. *Florida caerulea caerulescens* (Latham)
Southern Little Blue Heron

Common in mangrove swamps, lagoons, and along the coast. The stomach of a male collected December 25 at Playa Grande contained fragments of small crabs. The specimen weighed 408.2 grams.

7. *Butorides virescens maculatus* (Boddaert)
West Indian Green Heron

Rather scarce; a few were observed at Punta Arena, Playa Grande, Puerto Negro and Cayo Verdiales.

* 8. *Nycticorax nycticorax hoactli* (Gmelin)
Black-crowned Night Heron

Fifty adults were observed at the lagoon at Playa Grande on December 25. This is the first record for the species in any of the smaller islands near Puerto Rico.

9. *Nyctanassa violacea violacea* (Linnaeus)
Yellow-crowned Night Heron

One was observed at Punta Arena on December 24, and two at Playa Grande the following day.

* 10. *Querquedula discors* (Linnaeus)
Blue-winged Teal

Eleven were flushed in open spots in mangrove swamps near Punta Arena on December 24. On December 28 one was observed at a small pool in a creek near Isabel II. Not previously recorded from the island.

11. *Nyroca affinis* (Eyton)
Lesser Scaup Duck

About 300 were present on the large lagoon at Playa Grande on December 25.

12. *Buteo borealis jamaicensis* (Gmelin)
West Indian Red-tailed Hawk

One adult was observed at Punta Salina on December 28, two at Ensenada Honda the next day, and one at Campaña on December 31.

13. *Pandion haliaëtus carolinensis* (Gmelin)
Osprey

Two were seen at Punta Arena on December 24.

14. *Falco sparverius loquaculus* (Riley)
Puerto Rican Sparrow Hawk

Rather scarce, observed only at Isabel II, Puerto Negro and Punta Salina. A male collected at Puerto Negro on December 28 weighed 94.8 grams. It had eaten an *Anolis* lizard, 2 grasshoppers (*Schistocerca colombina*), and a spider.

15. *Rallus longirostris limnetis* Oberholser
Puerto Rican Clapper Rail

Recorded at Punta Arena, Playa Grande, and Cayo Verdiales.

* 16. *Porzana carolina* (Linnaeus)
Sora Rail

Two were observed and a male weighing 101.9 grams was colleced at Playa Grande on December 25, constituting the first record for the island.

17. *Gallinula chloropus portoricensis* Danforth
Antillean Gallinule

Common at Punta Arena, Playa Grande and Puerto Negro.

* 18. *Fulica caribaea* Ridgway
Caribbean Coot

Two observed at Playa Grande on December 21 form the first record for the island.

* 19. *Charadrius vociferus vociferus* Linneaus
Killdeer

The migratory variety of the Killdeer has not previously been recorded from Vieques. On December 28 a female was collected from a flock of three at Puerto Negro. It weighed 80.3 grams, and its stomach contained 12 Stratiomyid larvae, fragments of Coleoptera, and some gravel.

20. *Charadrius vociferus ternominatus* Bangs and Kennard
Antillean Killdeer

A flock of six of the resident variety of the Killdeer was observed at Punta Salina (December 28), and a female weighnig 74.3 grams was collected. Its stomach contained exclusively insect fragments, 95 per cent of them being Coleoptera, largely weevils.

21. *Actitis macularia* (Linnaeus)
Spotted Sandpiper

Three were observed at Punta Arena on December 24, two at Playa Grande the 25th, and one at Puerto Negro the 26th.

22. *Totanus flavipes* (Gmelin)
Lesser Yellowlegs

Common; observed at Punta Arena, Playa Grande, Puerto Negro and Cayo Verdiales. A female collected at Puerto Negro December 26 weighed 77.7 grams, and had eaten a large number of insects and their larvae.

23. *Zenaida aurita zenaida* (Temminck)
Zenaida Dove

A few were observed at Puerto Diablo and Cayo Verdiales, and larger numbers at Punta Salina, where on December 28 a female weighing 116.7 grams was collected. Its crop contained seeds and small stones.

24. *Columbigallina passerina portoricensis* (Lowe)
Puerto Rican Ground Dove

Comon and generally distributed. A female collected at Punta Arena December 24 weighed 31.1 grams, and a male from Puerto Negro December 27 weighed 32.8 grams. Both had the bill red at the base and dusky at the tip, and both had eaten large numbers of small seeds.

25. *Coccyzus minor teres* Peters
Mangrove Cuckoo

Males collected at Puerto Diablo December 27 and at Campaña December 31 weighed 58.3 and 61.4 grams respectively. The first had eaten 2 katydids (*Microcentrum*) and 21 eggs of the same. The stomach of the second contained a large walking stick and 16 katydid eggs.

26. *Crotophaga ani* Linnaeus
Ani

Common; observed at many localities. Two females were collected at Campaña on December 26. One of these contained an egg wiht a fully formed shell, blue with a white chalky covering. They weighed 88.5 and 115.6 grams, and their stomachs contained 95 per cent of insects, consisting of 2 grasshoppers (*Schistocerca colombina*), Coleoptera, and other insects. A small crab in one stomach formed the other 5 per cent of the food.

27. *Gymnasio nudipes newtoni* (Lawrence)
Newton's Owl

Inhabitants of the eastern part of the island gave me very convincing evidence that owls occur in the wooded hills slightly west of Punta Salina, but it proved impossble to capture any during our stay to determine if true *nudipes* or *newtoni* is the form found there. It is here listed as *newtoni* tentatively on the basis of probability.

28. *Antrostomus carolinensis* (Gmelin)
Chuck-will's widow

A pair was observed and the male collceted on a dense brush covered hill at Punta Salina on December 28. The specimen weighed 133.5 grams, and its stomach contained comminuted insects, mostly Coleoptera, including *Phyllophaga* and several species of weevils.

29. *Orthorhynchus exilis exilis* (Gmelin)
Crested Hummingbird

Common; observed at many localities. A pair was collected at Punta Arena on December 24. The male weighed 2.5 grams and the female 2.4 grams.

30. *Sericotes holosericeus holosericeus* (Linnaeus)
Blue-breasted Hummingbird

Common at Punta Arena, where a male weighing 5.3 grams was collected on December 24. One was observed at Punta Salina on December 28.

31. *Megaceryle alcyon alcyon* (Linnaeus)
Belted Kingfisher

Seven individuals were observed during our stay, at Punta Arena, Playa Grande and Puerto Negro.

32. *Melanerpes portoricensis* (Daudin)
Puerto Rican Woodpecker

Fairly common on the hills covered with brushy woods in the eastern half of the island. Two males collected weighed 70.7 and 72.4 grams, and an unsexed bird weighed 64.7 grams. Of the stomach contents of these three birds Cerambycid larvae formed 35.0 per cent; a Buprestid larva 3.3 per cent, insects, largely Coleoptera, including

a weevil of the genus *Anchonus,* 33.3 per cent; a scorpion 5 per cent, and large seeds of some drupe 23.4 per cent. A large parasitic nematode was found loose in the body cavity of one of the specimens.

33. *Tyrannus dominicensis dominicensis* (Gmelin)
Gray Kingbird

Very common and generally distributed. As many as eight were noted perched in one tree. The stomach contents of three specimens consisted exclusively of Hymenoptera. One bird had eaten a spider wasp, *Pepsis rubra;* another 8 bees, *Monobiella atrata* and the third 2 wasps, *Eumenes ornatus.* Two males weighed 45.5 and 42.3 grams, and a female 44.9 grams.

34. *Tolmarchus taylori* (Sclater)
Puerto Rican Petchary

Common in the brush-covered hills of the eastern third of the island, particulraly in the vicinity of Puerto Diablo. Other localities at which it was fairly common were Campaña, Ensenada Honda and Punta Salina. Three specimens were collected, their stomachs containing 63.3 per cent of vegetable matter (drupes), and 36.7 per cent of animal matter (a weevil and a katydid, *Microcentrum* sp.). Two males weighed 52.9 and 52.2 grams, and a female 53.7 grams.

35. *Myiarchus antillarum* (Bryant)
Puerto Rican Flycatcher

Not definitely identified on our visit, though a bird seen at Cayo Verdiales on December 30 may have been this species. A local hunter who claimed to know the species well stated that it was common before the hurricane of 1928, but that it has practically disappeared from Vieques since then.

36. *Elaenia martinica riisii* Sclater
Riise's Elaenia

Very common in brushy country in all parts of the island, and found even in the drier parts of the mangrove swamps, as at Punta Arena. Seven specimens were collected with some difficulty, as the birds have a habit of remaining concealed in the foliage when singing. Their stomachs contained 97.7 per cent of drupes and seeds, and 2.3 per cent of small weevils. All the specimens were males, and they weighed 18.1, 18.2, 18.6, 18.7, 19.0, 19.6 and 19.6 grams (average 18.83 grams).

* 37. *Hirundo erythrogaster* Boddaert
Barn Swallow

Six were observed at Puerto Diablo on December 27, one at Cayo Verdiales on December 30 and three at Campaña on December 31. Not previously recorded from the island.

38. *Mimus polyglottos orpheus* (Linnaeus)
Jamaican Mockingbird

Common in the eastern part of the island, not observed in the western end. A male collected weighned 52.7 grams, and two females 50.7 and 55.1 grams. Their stomachs contained vegetable matter 88.7 per cent (wild berries and drupes, and a wild solanaceous fruit), and animal matter 11.3 per cent (a large Geometrid larva in one stomach).

39. *Margarops fuscatus fuscatus* (Vieillot)
Pearly-eyed Thrasher

Fairly common on brush-covered hills in the eastern part of the island. A specimen was collected at Punta Salina December 28, and two at Ensenada Honda the next day. All were males, and weighed 91.2, 99.4, and 104.6 grams respectively. The first had eaten two red fruits known as muñeco (apparently *Cordia borinquensis*), the latter two stomachs contained fruits each of which had 2 coffee-like seeds.

40. *Coereba portoricensis sancti-thomae* (Sundevall)
Virgin Islands Honey Creeper

Common and generally distributed. Three males collected weighed 9.3, 9.7 and 10.5 grams, and a female 9.4 grams. Two stomachs were empty. The other two had had fruit pulp 35 per cent, and small insects and spiders 65 per cent.

41. *Mniotilta varia* (Linnaeus)
Black and White Warbler

One was observed at Punta Arena on December 24.

24. *Compsothlypis americana pusilla* (Wilson)
Northern Parula Warbler

Very common, as many as fifty being observed in the course of a morning's collecting. Nine were collected for a study of plumage variation. Five males weighed 7.2, 7.3, 7.3, 7.3, and 7.5 grams

(average, 7.32 grams), and three females 6.5, 7.1, and 7.1 grams (average 6.9 grams). One unsexed bird weighed 8.0 grams. The nine stomachs contained exclusively insects and their larvae and eggs, and spiders. Lepidoptera were represented by caterpillars and the eggs of moths. Coleoptera of many kinds were found, including weevils, fleabeetles, and a small ladybird beetle, *Scymnus floralis roseicollis*. Some Locustid eggs and various species of Diptera were also encountered.

43. *Dendroica petechia cruciana* Sundevall
Puerto Rican Golden Warbler

Common, both in mangrove swamps and in dry brushy regions. A female weighing 10.9 grams was collected at Punta Arena on December 24, and a male weighing 10.7 grams at Puerto Negro on December 27. The stomachs of both contained comminuted insects.

44. *Dendroica coronata coronata* (Linnaeus)
Myrtle Warbler

Two were observed in a mangrove swamp at Punta Arena December 24, and one of them, a male, was collected. It weighed 11.4 grams, and its stomach was filled with comminuted insects.

45. *Dendroica adelaidae* Baird
Adelaide's Warbler

Common on brush covered hills in the vicinities of Puerto Diablo, Punta Salina and Ensenada Honda, and a few were observed at Cayo Verdiales and Campaña. They were noticeably very much shyer than on Puerto Rico, remaining hidden in the densest brush. It was as a result of much strenuous effort that three specimens were secured. Two males weighed 7.1 and 7.3 grams; the third was too damaged to save. The three stomachs contained insects and their eggs, caterpillars and spiders. Fleabeetles and Fulgoridae of the subfamily Issinae figured largely among the insects. Eight large moth eggs were found in one stomach.

46. *Dendroica discolor discolor* (Vieillot)
Prairie Warbler

Common; observed in many localities. Males collected December 26 at Puerto Negro and the next day at Puerto Diablo each weighed 7.4 grams. Their stomachs contained exclusively insects

with the exception of one small spider. Diptera and Coleoptera predominated among the insects; a fleabeetle of the genus *Nodonotus* was detected in one of the stomachs.

47. *Seiurus aurocapillus* (Linnaeus)
Oven-bird

Males collected at Ensenada Honda December 29, and Campaña December 31 weighed 19.6 and 17.2 grams respectively. Their stomachs contained 50 per cent of seeds and 50 per cent of beetles (mainly weevils and Carabidae), in addition to sand and gravel.

48. *Seiurus noveboracensis noveboracensis* (Gmelin)
Water-thrush

Observed frequently during the period of our visit. Females were collected at Punta Arena on December 24 and at Cayo Verdiales on December 30, weighing 14.3 and 15.6 grams. The first had eaten 2 dragonfly naiads, the second miscellaneous insects, including Coleoptera.

* 49. *Oporornis philadelphia* (Wilson)
Mourning Warbler

One was observed in a dense lowland thicket at Ensenada Honda on December 29, but it proved impossible to collect it.

50. *Setophaga ruticilla* (Linnaeus)
Redstart

A brliliant male was collected December 29 at Ensenada Honda. It weighed 7.6 grams, and its stomach contained exclusively insects and their eggs. Homoptera formed 70 per cent, including 2 leaf-hoppers, *Colpoptera maculifrons.* 5 moth eggs formed 10 per cent.

51. *Holoquiscalus niger brachypterus* (Cassin)
Puerto Rican Grackle

Decidedly scarce and local at the time of our visit, though it was stated to be common at the time of cane harvesting. One was seen at Mosquito on December 24, and five at Cayo Verdiales on December 30, of which three were collected. Of these an immature female weighed 53.5 grams, an immature male 54.9 grams, and an adult male 83.8 grams. Their stomachs contained 66 per cent of vegetable matter (fruits and laves) and 34 per cent of insects, mainly Coleoptera and lepidopterous pupae.

53. *Tiaris olivacea bryanti* (Ridway)
Bryant's Grassquit

Comon in the vicinities of Campaña, Ensenada Honda and Cayo Verdiales. A male was collected at Campaña on December 26, and three males at Cayo Verdiales on December 30. They weighed 7.8, 8.5, 7.7 and 7.6 grams respectively. Their stomachs contained small seeds and sand.

52. *Tiaris bicolor omissa* Jardine
Carib Grassquit

Abundant and generally distributed. A male weighed 9.7 grams and a female 10.2 grams. Their stomachs contained small seeds and sand.

* 54. *Ammodramus savannarum borinquensis* Peters
Puerto Rican Grasshopper Sparrow

Two were noted in a grassy field dotted with brushy trees at Cayo Verdiales on December 30, but as it proved imposible to collect any to determine with certainty their subspecific identity, they are here listed under the name of *borinquensis* on the grounds of probability, no Grasshopper Sparrows having been previously reported from Vieques.

NESTING OF THE PUERTO RICAN ORIOLE

By Nina G. Spaulding

The Puerto Rican Oriole (*Icterus portoricensis* Bryant) is peculiar to the island of Puerto Rico. It is a common resident of the *finca at* Algarrobo, between Vega Baja and Manatí already described in my paper on Latimer's Vireo.

Song and call notes.—This species has a very pleasing song of distinctive oriole quality. It was rarely heard during the time included in these observations except at dawn, with a possible subdued repetition or two between daybreak and 7 A. M. The singing began at the first signs of light and lasted through the period of dusk. It ceased the instant that it was broad daylight. During the time that these observations were made, it began about 5 A. M. and ended about 5.25 A. M. The song was suggestive of the words, *Merry Cheví—c'm out here.* Squeaking, liquid gurgling notes were thrown in to embellish the main theme. These were inaudible at any distance. They occurred on the word *here* as follows: 1. *Here* ommitted entirely. 2. Pause between *out* and *here.* 3. Chucks, squeaks, clear whistles or additional syllables uttered between *out* and *here.* *Cheví* was the word audible at the greatest distance, and was the one most frequently employed in the daytime songs. These latter were of rather infrequent occurrence. They were often subdued and consisted of portions of the early morning song, or of a variety of notes, sometimes not more than three, but recognizable by the quality of the tone.

Although the song was of such pleasing quality, the call note was hoarser than that of the *Mozambique* [*Holoquiscalus niger brachypterus* (Cassin),] and was very similar. It was a harsh *chuck,* and was quite constantly heard in the vicinity of the nest throughout the breeding season. Both male and female uttered these notes, but one much more frequently than the other and in a louder tone. That one I believe to have been the male, since he was the one on guard.

Nest.—Nests of two pairs of this species were located in 1931. The first, found on April 22 contained an incubating bird within 7 days of hatching; the second, seen on June 3 was occupied by 3 young. The first was in a young, low cocoanut palm about a five minute walk from human habitation; the second was in a royal

palm, about 25 feet in height that was situated at the foot of an abruptly sloping hill, at the crest of which was a house.

Nests of these orioles are especially difficult to find, due to both the altitude at which they build and to the manner of placing their nests. They build beneath the long drooping leaves of palm trees. The nest is a rather flattened out affair, packed so closely against the mid-rib that it easily eludes detection. This was well illustrated by the nest in the cocoanut palm. It was so well hidden that it barely escaped the *machete*. Some men had already slashed off two leaves on the tree, and were about to cut the third, when one of them saw the nest beneath the leaf, and fortunately witheld the knife. This was a particularly happy discovery since the tree was so young that it was only about 15 feet in height, and the leaf utilized by the pair was one of the lowest on the tree, making it ideal for observation. The leaf had a less acute upward slant than those above it, making the under side less exposed to view.

The nest was located under the mid-rib at the highest point of its curve, and was 12 feet from the ground. The mid-rib ran north and south. On the east side, the pinnae were long, closely set and quite even. On the west, they were more jagged, and near the stem were quite short. The nest was composed of long, thread-like fibers, evidently taken from both the tattered edges of palm leaves and the matting which encircles the stems. That was the only material employed with the exception of a makeshift lining of *Tillandsia* stems. The palm fibers were thickly matted and interwoven making a very durable nest, but inside there was a thin layer of slightly finer fibers that was not interwoven but that had been dropped in losely and then shaped by the bird's body to form a shallow cup. It was 2½ inches deep and 4 inches in diameter at the rim. From it radiated 4 straps, composed of the same matted material as the nest. They ran parallel to each other, about 7 inches apart, two extending south from the nest, parallel to the mid-rib, and two north. The total length from the end of one strap to the end of the other, on the west side was 2 feet 4 inches. This included the nest. On the east side the total length of straps and nest was 2 feet 6½ inches. The number of pinnae covered on the west side was 20, and on the east side, 24. These straps were secured to each of the 20 and 24 pinnae by a thread of palm fiber looped through the edge of each pinna, and what is most remarkable, the looping unfailingly occurred on the same side of the mid-rib of each pinna (the south). Not a single pinna was skipped the entire length of the straps. In width the

straps varied from ½ inch to 1 inch. The place of attachment on the east side measured 5 inches from the mid-rib, and 4 inches from the mid-rib on the west side. The nest hung 3 nches below the mid-rib. At one place an extension of the nest rim occurred and was utilized by the pair as a landing place.

Eggs.—Three eggs composed the clutch. They were very pale blue(almost white. One egg was a shade bluer than the other. The third egg had already hatched. The spots on the two eggs varied. On one, the larger end was completely washed with pale rufous brown, extending almost to the center of the egg. The remainder was sparsely sprinkled with small spots of the same color. The larger end of the other egg was wreathed with heavy splashes of almost seal brown, while the rest of it was lightly sprinkled with some small and some larger spots of the same color. One egg measured 23½ mm × 17½ mm; the other, 24 mm × 17 mm.

Incubation.—This labor was performed by only one of the pair, presumably the female. The other did guard duty. Its special perch was about 60 feet from the nest and was a tall *icaco* sapling that arose from a dense group of the same species. It terminated in a dead twig. From that it had an extended view of the surrounding territory, which it scanned with an eagle eye. At the appearance of any disturbing element it would set up a nervous reiteration of the *chuck* note. It learned to recognize my approach when yet a long way off. Whenever I was forced into the open from lack of the protection of wayside brush, the bird would set up an irritating series of protesting *chucks.* Neither would it be fooled by any blind, but would vigorously attempt to force out the concealed intruder by rapid repetition of the same note, and also by flying close about the blind. However, in spite of these manifestations of displeasure, the normal activities at the nest were not often retarded. Sometimes the supposed used the guard tree as a stopping place, when en route to the nest. It was not an uncommon sight to see the pair perched there together.

When away from the nest the incubating bird was joined by its mate and both flew off together. A favorite feeding ground of the pair was a brushy tract, some distance from the nest, but their feeding territory seemed to have no well-defined boundary. Dead branches were favorite perches.

Both the approach and departure from the nest by the incubating oriole was accomplished very stealthily. The palm leaf concealed the bird so completely that many times it escaped unseen.

It evidently crept out of the nest between the pinnae or flew out between the shortest ones on the other side of the leaf from the observer. At other times it dropped down to within a foot or two of the ground, then dashed up and off.

One day, at 12.55, a subdued song was heard. It consisted of a few notes of the early morning song. That was the only song noted during incubating activities. The only other sound emitted was the *chuck* note. That was occasionally heard both when the supposed female left the nest and when she returned, as well as when she was on the nest. On April 24, from 10.25 A. M. to 1.03 P. M. that note was recorded 6 times.

Torrential showers of almost daily occurrence and the evasive escape of the female from the nest combined to so handicap observations that the length of only two incubating periods were positively secured. One was of 41 minutes duration; the other, 28 minutes.

Rearing of the Young.—One egg was found hatched on April 29, at 10:10 A. M. The young bird was not yet dry. An excessive, all-day rain prevented continued observations, so the exact time of the hatching of the other two eggs is not known. The young were first seen out of hte shell April 30, at 9.26 A. M. The supposed male now assumed in addition to guard duty, that of assistant provider, while the supposed female acted as brooder and did her share of feeding the young. As far as the observer was able to ascertain the supposed male took no part in the brooding.

Brooding occurred most frequently on the first day, April 30. During 2 hours, 6 minutes spent at the nest in the morning, the bird brooded 4 times. The longest period was 20 minutes, the shortest 9 minutes. The longest period off the nest was 40 minutes; the shortest, 22 minutes, averaging a brooding every 31½ minutes. In the afternoon from 4 to 5.25, there were 3 broodings, one lasting 8 minutes, one 9 minutes, with the length of the last one which occurred at 5.25, undetermined. In the morning of the second day, during 3 hours 20 minutes spent in observation, brooding occurred 4 times, averaging one period every 50 minutes. The length of these periods in minutes was: 14, 11, 8, and 11, respectively. In the afternoon, during 2 hours, 15 minutes at the nest, only one brooding took place. It lasted 15 minutes. On the third day, only 2 broodings occurred, during 1 hour 52 minutes observation, an average of one every 56 minutes. There were no observations on the 4th day, and on the 5th day, only one brief period of 4 minutes was noted. No brooding occurred after the 5th day.

The average frequency of feeding during the first 5 days while brooding was in progress was about once every 15 minutes. On the 6th day, the frequency increased to an average of a feeding every 6¾ minutes in the morning and every 5⅕ minutes in the afternoon. This average held practically the same through the 7th and 8th days. No observations were made on the 9th and 10th days. On the 11th day feedings took place every 7½ minutes. No observations occurred on the 12th day. On the 13th day, the last the young were in the nest, feedings averaged every 8½ minutes in the morning and every 4 minutes in the afternoon. Total average for the time observed was a feeding about every 6 minutes, after the 5th day. Twice on the second day, the supposed male was seen to carry insects to the brooding bird. That was the only time such behavior was noted.

The favorite alighting place of the pair when en route to the nest was the mid-rib of the palm leaf, under which the nest was swung. There they would sit, sometimes one alone, but many times both together, chucking, or drubbing insects, waiting until they considered it safe to approach the nest hidden below.

When feeding the young, the pair often clung to the side of the nest, with tail curved under it. They also fed from the rim. A favorite landing place was that part of the nest rim that was particularly wide. If any disturbance were heard outside while the birds were within, they had the habit of clinging to the base of the nest, head down, and peering in all directions before venturing forth. Exit was usually made by flight toward the stem end of the leaf, but sometimes from under the tip.

The pair showed greater annoyance at the presence of an observer than during incubation. Any attempt to approach the nest was provocative of rapid, excited chucks.

As during incubation, the guard tree was frequently occupied by the supposed male, especially while the female was brooding. At times he kept up a constant chucking; again, only an occasional note was heard. The *chuck* note was often uttered near the nest, both as a scold and warning note and as a conversational note. Sometimes it was loud and was uttered rapidly. At others it was casual and subdued. Both male and female emitted it, but the supposed female much less frequently than the male, and the tone was pitched lower and was softer. Both birds often chucked before going to the nest and immediately after leaving it.

Two long distance flights were noted. The first occurred at 2 o'clock on the 5th day. The pair flew from the guard tree, high above the tree tops, over the open country toward the west, and out of sight. After 5 minutes, one alighted on the mid-rib with an insect dangling from his bill. Only one bird went on the second flight. That took place on the 7th day. The bird was away 14 minutes.

Excrement sacs were evidently eaten during the early care of the young. It was not until the 13th day that they were noted being carried out of the nest by the parents. At 12.23, 3.07, 3.54, and 4.20 pellets were carried from the the nest in the bill.

As the time approached for the departure of the young from the nest, the pair became exceedingly nervous about my presence.

The departure of the young from the nest was unwitnessed. It occurred on the 13th day of May, 14 days after the hatching of the first egg. Four days later one of the parents was seen searching for insects followed by one young fledgling. The latter was constantly emitting a loud call note, *yeep yeep yeep*.

Young.—The general color of the freshly hatched young was reddish orange. The center of the belly was mouse gray encircled by adjoining areas of red, yellow, orange and brown; the mandibles were pale orange edged with ivory white; the legs were orange; the nails and tip of the upper mandible were ivory white.

The color of the ball of the eye was slate gray; the iris, orange and the pupil mouse gray.

Natal down was sparse and was distributed in rows. A row followed the contour of each eye, next to the center axis of the head, beginning at the nostrils and terminating at the crown; one also followed the contour of the shoulder, elbow and hip joints on the upper surface. The margin of the wing was edged with it. Two tufts of hairs occurred at the knee joint, on the tail and on the nape of the neck. A row extended along the spine from the rump, half way to the head. On the belly a row followed the contour of each hip joint. The color of the down was pale gray, except that on the belly knee and elbow joints, which was white.

On the 3rd day, the oldest nestling showed wing quills just pricking through. By the 4th day the two youngest had begun to develop them, also. Those on the oldest one were longer and the down on the spine was disappearing.

When the young left the nest on the 14th day, the plumage was noted as follows; head, very dark brown; back, a shade lighter than the head; rump and tail, brown; wings, slate gray, edged

with buff; breast, light buffy brown; belly bare; sides, ochre yellow; under tail coverts, light yellow; general appearance, dark brown or slaty on top and buffy beneath.

During the early part of their existence, the young made peeping sounds. This was first noted immediately after hatching, when one was in my hand. These sounds were inaudible on the first day from within the nest, but by the third day could be heard, if one were directly beneath it. By the 5th day they had increased in volume to such an extent that they were audible in the blind, several feet away. When the young heard their parents chucking on the mid-rib above them, they peeped lustily. By the 11th day they had developed a call note. It was emitted loudly and rapidly and was suggestive of the syllables, *ti ti tí, ti ti ti teé, tit ti ti teé.* When ou of the nest the call note was a loud *yeep.*

The Royal Palm Nest.—This nest, located on June 3, differed from that in the cocoanut palm, in that it had no radiating straps. It was attached to the leaf pinnae in only three places, with intervals of 4 pinnae and one pinna between attachments. It suggested a swinging basket. The heads of two young were visible above the rim. One of the parents was a bird in immature plumage. On June 9, one of the fledglings was found out of the nest in the bushes at the foot of the tree. On June 10, the remaining two young were still in the nest, but one had climbed out on the platform-like broadening of the nest rim between two of the attachments to the leaf. The other stood on the rim. The mature parent was seen to feed them, and was followed by the immature bird, which, after feeding carried out an excrement sac. During 42 minutes observation, the mature parent fed 4 times and removed excrement sacs twice. The immature bird fed once. However, the demands of the fledgling already out of the nest may account for the seeming neglect by the immature bird. At 9.40 one young was on the platform apparently eager to fly, but afraid. By 9.50, the other fledgling was standing on the nest rim. At 9.55, one climbed farther out over the rim, them clinging to the nest, turned around, with tail hanging down. That was enough of a venture for one time; both fledglings climbed back into the nest and settled down, out of sight. They were fed twice, first by the immature parent, then by the mature one. After the latter flew, he chucked 20 times in a minute.

At 3 P. M., on the same day, one of the parents was seen clinging to the very tip of the terminal shoot of the royal palm. One fledgling had vacated the nest altogether. The other was clinging

to the rim. One leg slipped; he drew it back as if afraid of falling, and climbed inside the nest, but was soon out again. This time he let go with his feet and tried his wings. He flew upward directly above the nest toward the mid-rib which was about 3 inches above him, then dropped back into the nest. Unfortunately, the final successful flight was unwitnessed, and was accomplished during a very few minutes absence from the nest. Upon return, the young were in the bushes at the foot of the palm, giving the *yeep yeep* call, and the parents were chucking nervously.

Before closing I wish to extend my most grateful appreciation to Dr. Stuart T. Danforth for the reading of the manuscripts and for his interest and assistance in innumerable ways; to Miss Elsie Mae Willsey for the use of her attractive week-end house at Algarrobo, which made possible these observations; and to the late Mr. William Burlingame for his hospitality and willing assistance rendered about the *finca*.

Jaffrey, New Hampshire.

SOME OBSERVATIONS ON THE NESTING HABITS OF ADELAIDE'S WARBLER

By Nina G. Spaulding

Adelaide's Warbler (*Dendroica adelaidae* Baird) is a species that is endemic to the island of Puerto Rico and the adjacent island of Vieques. It is a common resident at Algarrobo (between Manatí and Vega Baja) on the same five-hundred acre *finca* already described in my paper on the nesting habits of Latimer's Vireo. The dense jungle of *icaco* brush so prevalent over the *finca* is a favorite haunt of both species. However, their preferences differ in one respect; while Latimer's Vireo is to be found most frequently on the border of dense brush, Adelaide's Warbler favors almost impenetrable tangles. It is found in dense growth scattered over pasture land. It was also a visitor in the tangled scrub about the house that had purposely been left in its native state.. It seemed undisturbed by the presence of man; all it asked to be a common visitor about the home was plenty of cover.

Song.—The song of this species is a clear, rather loud trill. It has several variations, as follows:

1. A rapid trill on one tone.
2. A rapid trill on one tone terminating with an upward inflection.
3. A rapid trill on one tone terminating with a downward inflection.
4. A rapid downward trill.
5. A downward trill followed by an ascending trill.
6. A descending trill terminated by an emphatic upward inflected weé.
7. A rapid trill on the same tone with a marked retardation on the downward inflected notes at the end, thus: *chch-chchch--ch---ch-----ch-----ch------ch--------ch.*
8. A song similar to that of the Nashville Warbler of North America.
9. The next song can be best indicated by a downward trill, a *ch--ch--ch*, and an ascending *wée.*
10. An up trill and a down trill, terminated with an emphatic, upward inflected *hu-é.*

The frequency of the song of the male, during an hour's observation on the morning of February 10, 1931 was as follows: 10.29, 10.38, 10.43, 10.48, 10.54, 10.59, 11.02, 11.23, 11.24, 11.26, 11.28,

11.31, 11.31½, 11.31¾, 11.32, an average of once every 4¼ minutes, the longest time between songs, being 9 minutes and the shortest, being 15 seconds. On February 28, an Adelaide's Warbler was heard singing all the afternoon in a brushy pasture, south of the house.

My notes on the pre-nesting activities of this warbler are meager. Two were seen feeding together on March 9 in dense shrubs by an *algarrobo* tree. They uttered a weak *chip* as they searched rapidly among the leaves for insects, and sang occasionally. Again, on March 19, two were noted singing in close proximity. They answered one another. If they were a mated pair or two males, remains undetermined. It is possible that during courtship the female has a short period of singing. On March 24 a solitary male (supposedly) was noted singing and feeding. He dashed out in sight, after an insect. The snap of his bill was like that made by the breaking of tiny dried twigs. On April 8, 1931, two birds were answering each other, separated only by a trail. They appeared to fly off in opposite directions which would indicate that they were both males. Thereby, any foregone conclusions that these pairs seen flying about in the early spring, feeding and singing responsively, are mated pairs, is precluded, which leaves the problem as to any singing on the part of the female still unanswered. On April 11, 1930, from 9.30 to 10, two birds were note singing responsively in a cocoanut grove. Also, on that date, a pair noted feeding together were not singing but were uttering the *chip chip* call note. As soon as one stopped, the other took it up. The latest record of responsive singing occurred on April 24, 1930. Two birds were singing in the bushes bordering the brook. One bird was in the dense shrubbery by the brook. The other was across a small open space in a clump of bushes. They were singing the different variations of their characteristic trill. After one sang the other replied instantly, sometimes by the same trill given by the first and sometimes by a different one. Once, the bird in the bushes by the brook flew across the open space into the clump of brushes where the other bird was feeding. The other chased it back, through the open space to its original feeding place by the brook, where the responsive singing continued uninterruptedly. If they were of the same or opposite sexes remains undetermined.

Nesting Season.—We have a few records to help us to establish the length of the nesting season of this bird. Wetmore (*Scientific Survey of Porto Rico and the Virgin Islands*, vol. IX, 1927, pt. 4,

p. 517) places the breeding season in May and June. The only records made up to 1921 are by Bowdish in 1900, Wetmore, 1912, and Suothers in 1921. Wetmore reports breeding activities on Vieques as early as the latter part of March. The next record was made in 1924 by Danforth (*Journal of the Department of Agriculture of Porto Rico,* X, 1926, p. 120). He reports finding a nest on May 6, and concludes that the birds apparently nest in May. However, there is evidence that breeding season extends over a longer period than those earlier records had led us to believe. Beatty (*Journal of the Department of Agriculture of Puerto Rico,* XV, 1931, p. 29) records an Adelaide's Warbler in the process of nest construction an early as April 14. On the 27th in the same month he located an incubating bird. More extended observations place the beginnings of nesting activities at a still earlier date. As early as April 9, (1931), I noted a pair of these warblers feeding juveniles that were evidently just out of the nest. They were also observed on the 11th, 12th and 24th. From this data we may conclude that the nest building season may begin at quite an early date in March. According o Wetmore's observations on Vieques, it would seem that the nesting period covers practically the same length of time on the two islands.

Nest.—Nests of this warbler proved exceedingly difficult to find. This was due to three reasons: their singing habits are such that they are of no aid at all in locating a nest; their nests are placed in such impenetrable, brushy tangles that one does not naturally walk in those places; they are so well concealed that if one passed a nest, the chances are that he would not see it. In view of these facts, I feel myself fortunate to have located even one during the three winters spent on the *finca.* That eventful occasion happened on the afternoon of May 7, 1930, and was probably due to the fact that the bird had inadvertently placed its nest not far from a trail, where there was a slight opening into the brush. A bulgy appearance among a thick cluster of leaves, near the top of an *icaco* shoot, about ten feet in height, aroused suspicion. Upon nearer approach, it proved to be the long-sought nest of this species. It contained an incubating bird, and was so well screened from view, that after completely encircling it, only one place was found sufficiently exposed for observation. There, between the leaves, the tail and back of an incubating bird could be indistinctly seen.

This nest was situated in the tallest of the surrounding *icaco* saplings. It leaned at an angle of about 45 degrees. Its terminal

fork consisted of a bunch of three or four upright twigs, heavily foliaged. It was in the midst of these that the bird had placed her nest. These twigs gave ample support, sustaining the nest in an upright position above the main stem, and the heavy foliage almost entirely concealed it. It was about 8 feet above the ground The nest was a closely woven, cup-shaped affair, and was composed of soft grass densely interwoven except on the outside at the base, where it was rather loose and dangling, and was composed of the coarser seed-stalks of grasses that were soft and tattered, being partially dessicated. It was lined with feathers.

Ornithological literature yields meager and varying reports on the nest of this species. Referring to the publications already mentioned, we find the following, which for comparison I have arranged as follows:

Authority	Elevation	Main Composition	Lining
Wetmore	4 ft.	gray moss	fine grass
Danforth	3 ft.	soft grass	none
Beatty (2 nests)	6 ft.	soft grass	feathers and hair
The writer	8 ft.	soft grass	feathers

Note the close agreement of Beatty's and the writer's reports. In the case of one of Beatty's nests, however, he found some cotton added to the feathers. In regard to Danforth's nest, as he says it was unoccupied may I venture to suggest that it was unfinished. The description of Wetmore's nest, which was also an unoccupied one suggests that of a Latimer's Vireo, except that no mention is made of the *Tillandsia* stems always used as the main composition in nests of this species. In view of reports on nests that were actually occupied, a question is raised, not satisfactorily answered, as to the employment of moss in the nest of this species.

Nest measurements were as follows:

$$\text{Diameter}\begin{cases}\text{Inside } 1\tfrac{3}{4}'' \times 1\tfrac{1}{2} \\ \text{Outside } 2\tfrac{1}{2}'' \times 2\tfrac{1}{4}\end{cases}$$

$$\text{Depth}\begin{cases}\text{Outside } 2\tfrac{1}{4}'' \\ \text{Inside } 1\tfrac{1}{2}''\end{cases}$$

Eggs.—The clutch observed consisted of 3 eggs. They were white sprinkled with small dots of reddish brown. A wreath of heavy splashes of the same color encircled the larger end. One egg measured as follows: 14½ mm × 11 mm. Only the one was measured due to fear of desertion on the part of the incubating bird.

Incubation.—This activity was allotted to the female, a conclusion reached because of the fact that the setting bird did not sing. When found on May 7, the eggs were within 11 days of hatching. During the first four days the approach to the nest was accomplished by alighting directly on the nest rim. On the 5th day, at 4.49 P. M., the bird came sneaking up the twigs behind the leaves, and stealthily crept into the nest from the farther side. From that time, this was her usual method of approach. When departing from the nest she usually dropped down into the bushes, but sometimes flew directly into the brush beyond. On May 15, when the eggs were within 3 days of hatching she showed greater caution on leaving the nest, by looking in every direction before flying or sliping down into the bushes. Until this day, she had kept herself absolutely invisible when away from the nest, but on the morning of the 15th at 10.04, when ready to leave it she spread her wings when in a sitting position and slowly crept out, behind some leaves, then down the branch about a foot, where she stood for a few seconds. She captured an insect, then keenly inspected the leaves for more, after which, she crept back up the twig and into the nest. The time out was 2 minutes. Later, at 11, she flew out of the nest and out of sight but in 1 minute was visible on a twig below it. She pecked at a leaf once or twice. In 3 minutes she was back in the nest, and again, on the some day, when she was off for 26 minutes, she was within sight of and not far from the nest during the last four minutes of her absence.

As to restlessness, her behavior on the nest varied. On May 11, she sat quietly in the morning until noon, when she began to show distress from the heat of the broiling noonday sun, by sitting with her bill open. The sun's rays fell between the *icaco* leaves directly upon her. At 12.32, she was sitting protractedly with bill open. At 12.38, she raised herself above the nest, and spread her wings, as if either for relief from the heat, or to cool the eggs. After 3 minutes, she preened, spreading on wing, then sat with bill wide open. 5 minutes later, she raised herself as if to admit air, and in 3 minutes, changed her position so that she was sitting with her side toward me instead of her tail. This position was maintained

for 7 minutes, when she changed again to her usual position, with tail toward me. Observations ceased at 12.57. On the 14th and 15th, when observations were resumed she was normally quiet. However, on the 16th, she became exceedingly restless. She was constantly rising, then settling, tucking her head under her breast, stretching her head over the rim of the nest and looking all around. The temperature that day was 99 degrees in the shade.

The following morning, May 17, the extreme nervousness of the bird noted on the 16th was lacking. She was incubating on my arrival and remained thus for 36 minutes sitting very quietly.

She was still feeling the effect of the heat, for her bill was open upon my approach and she at once arose and remained standing during 4 minutes. She turned the eggs 3 times during the morning. This was the day preceeding the hatching of the eggs.

The length of the incubating periods varied from 20 minutes to 36 minutes. The average for one period was 26 minutes. 14 hours 27 minutes was the total time spent in observation during incubation. The female incubated a total of 7 hours 12 minutes or about half of the total time of observation.

The male proved himself an adept at complete concealment during this time. Not once was even a glimpse of him obtained. He sang, but chiefly over in the brushy tract that lay across the trail from the nest. Occasionally, however, he was heard in bushes adjacent to the nest, but he was such a wanderer and his songs were so infrequent that one could never locate his nest, by following his voice.

Rearing of the Young.—The eggs hatched on May 18, 11 days after the nest was found. Both parents shared in the care of the offspring. The similarity in the plumage precludes any definite statement in regard to the first appearance of the male at the nest. On May 19, the day after hatching, at 3.55 P. M., the first positive knowledge was obtained on that score when both birds appeared at the same time, and one of them sang, thus proving himself to be the male. At 4.02, one of the pair fed and brooded. At 4.06, the male sang, proving that it was the female who was on the nest. When she heard him, she perked up her head and slipped off. At 4.10, both birds again arrived at the nest. One of them fed the young, and then the other crept inside and brooded. At 4.17, the brooding bird flew and the young were left uncovered. The nest was vacated by the parents for 24 minutes, though one feeding occurred during that time. At 4.41, the pair again arrived at the nest

together one feeding and the other brooding as before. No singing was noted while this bird was on the nest. I concluded that the brooding bird was the male and that he shared in the brooding as well as in the feeding.

Excrement was eaten 5 times from 9.30 to 11.50 in the morning and twice from 2.30 tc 5.32, in the afternoon. During that time, there were 17 periods of brooding, the longest lasting 17 minutes, and the shortest, 3 minutes. The average length of a brooding period was 8 minutes, 45 seconds. The longest time the young were left uncovered was 29 minutes; the shortest, 4 minutes, the average being 13 minutes 22 seconds. Feedings averaged every 17 minutes 53 seconds.

On the following day, May 20, observations were made from 9.25 to 12. Not once did both of the birds arrive at the nest at the same time. At 11.46, when the brooding bird flew, the mate instantly arrived at the nest with insects, proving that both birds were working. There were 6 periods of brooding, during 3 of which, there was no singing on the part of the bird off the nest, possibly indicating that the brooding bird was the male though it was not positive proof. The length of the 6 brooding periods in minutes was 3, 15, 13, 15, 9 and 6, respectively. The periods when the female was known to be brooding because the male was heard singing, were longer than when no singing was heard, being the periods that were 15, 13 and 15 minutes in duration. Brooding periods averaged 10 minutes 10 seconds as compared with 8 minutes 45 seconds on the previous day. The longest time that the young were left uncovered was 25 minutes and the shortest 7 minutes, as compared with 29 minutes and 4 minutes on the .previous day. The average time uncovered was 15 minutes 40 seconds. Feeding occurred 18 times averaging every 8 11/18 minutes as compared with every 17 minutes 15 seconds on the previous day. Times between fedings in minutes were 4, 2, 4, 5, 2, 3, 2, 3, 22, 16, 35, 2, 7, 15, 9, 4, 5 and 9 respectively. The longest were during the brooding periods, when the young were never fed, with the exception of one occasion, subsequently noted.

Excrement was eaten by the bird before entering to brood. At 10.07, for the first time a sac was carried out of the nest into the bushes, and dropped. The male averaged a song every 9½ minutes. Two periods of unusual frequency occurred, the first lasting from 10.45 to 11.01. He sang 35 times, averaging a song every 7 seconds. The second period began at 11.46 and ceased at 11.54, when one of the pair began to brood. No more singing occurred while the brood-

ing was in progress. The insects fed were larger than on the first dy, most loads being visible as they protruded from the bird's bill.

On May 21, the third day, two changes in behavior on the part of the parents were noted. The minute the brooding bird flew the mate took her place, and once the mate brought the brooding bird an insect, who in turn fed it to the young. When a camera was set up, the brooding bird remained tenaciously on the nest until it was directly in front of and very close to her, when she flew. It was a long time before either of the pair returned. Scolding notes and an occasional song could be heard, until finally, one ventured up the branch below the nest, but was too frightened to enter. After a few minutes another attempt was made with the same result. The third attempt was successful. One of the pair crept up the branch to the nest rim and fed the hungry young. Insects were then brought 4 times in quick succession. The click of the camera was unheeded by the busy pair.

It will be noted that these warblers offered no resistance when the nest was approached. However, in time of extreme danger they became ardent defenders of their offspring, even to risking their own lives. It was not by direct attack, but by behaving in such a manner as to attract attention to hemselves, and thus away from the young. An exhibition of this sort occurred the first day the young were out of the eggs. The owner of the *finca* inadvertently passed directly in front of the nest when mounted on his horse. He did not see it, but his eye was at once attracted to something fluttering in the grass at his horse's feet, which he soon made out to be a bird. Then he saw the nest and that it contained young birds. The parent had made as big a commotion as a small bird could, to draw attention away from her newly hatched young.

On May 21, it was noted that the excrement sacs were both eaten and carried away by the parents.

An examination of the young, when 6 days old disclosed a row of black pin feathers tipped with white extending down the spine. Similar ones were also visible through the down on the head. On the sides, directly below the wings was a row of yellow pin feathers. The wings were bare. The bill as dark gray edged with white. Legs and feet were gray. Unfortunately observations during the remaining days of the nesting cycle were prevented by the necessity of other duties which prevented the author from continuing her observations.

NEW EUPTERYGINE LEAFHOPPERS FROM PUERTO RICO

(Homoptera—Cicadellidae)

By P. W. OMAN,
United States Department of Agriculture, Bureau of Entomology and Plant Quarantine.

Included in this paper are descriptions of five apparently new Eupteryginae for which names have been requested. Two of the species, *Dikraneura cedrelae* and *Empoasca papayae*, are reported to be of considerable economic importance. Thanks are due Dr. L. F. Martorell and Dr. J. H. Jensen for furnishing additional specimens of these two species upon request.

Protalebra brunnea, n sp.

FIGURE 1

In size and general form resembling *Protalebra octolineata* Baker, but darker brown in color and with the color pattern somewhat like that of *Protalebra omega* Van D. Length 2.6–2.75 mm.

General ground color brown; face, legs, disk of crown, and portions of pronotum and scutellum paler. Fore wing with a broad, fuscous-bordered, cream to ivory vitta curving from near apex of scutellum to middle of costal margin and then back to commissural line near apex of clavus, the vittae on the two fore wings thus forming an irregular ovate mark; a small, irregular, ivory spot at apex of clavus and a larger one opposite this on the costal margin, both partly bordered with fuscous; apical cells smoky subhyaline.

Head slightly narrower than pronotum; crown short and bluntly rounded. Lateral margins of pronotum diverging posteriorly, posterior margin shallowly concave. Fore wings relatively short and broad. Seventh sternite of female much longer than preceding sternite, posterior margin with a short, triangular projection medially. Male plates smaller than those of *octolineata* but relatively broad basally and tapering gradually to blunt tips.

Aedeagus very broad and rather short, distal portion curved abruptly upward, apex with a pair of short, finger-like processes which extend laterad and slightly cephalad. Connective very short. Style stout, slightly curved, notched on outer margin distally and with tip bent outward.

Holotype male, allotype female, and 1 male and 1 female paratype from Villalba, Puerto Rico, June 28, 1934, R. G. Oakley. Types in collection of the United States National Museum (Cat. No. 52086).

Joruma neascripta, n. sp.

FIGURE 2

Related to *Joruma ascripta* McAtee, with which it agrees in general habitus and wing venation, but slightly smaller and with the male plates broader, shorter, and bent upward posteriorly. Length 2.5 mm.

Anterior margin of head between eyes bright red; eyes dull red to brown above, sordid yellow below. Face and legs pale yellow. Crown, pronotum, and scutellum sordid brownish-yellow, the scutellum with a pair of triangular fuscous marks basally. Fore wing sordid yellow on basal one-half, with an extension of this color along costal margin to first cross-vein; remainder of fore wing smoky fuscous subhyaline. Hind wing smoky subhyaline. Abdomen brown to yellowish-brown.

Crown bluntly rounded, median length less than basal width. Pronotum short and broad, scutellum relatively large. Wings shorter than in *ascripta*. Posterior margin of seventh sternite of female triangularly produced. Male valve very small; plates rather broad, not slender and finger-like as in *ascripta*, and with the distal one-third bent abruptly upward.

Aedeagus relatively short; middle portion broadened for muscular attachment and bearing a pair of slender, blunt-tipped processes which extend caudally; terminal portion carrying ejaculatory duct short and curved upward. Style broad medially, with a slender, hair-like seta arising on outer margin beyond middle and extending backward and outward. Distal portion of style long, slender, and sharply pointed.

Holotype male, allotype female, and 1 male paratype from Manatí, Puerto Rico, May 2, 1933, on "hicaco", *Chrysobalanus icaco* L. One male paratype from D'Abadie, Trinidad, Oct. 15, 1918, H. Morrison (A 761). Types in collection of the United States National Museum (Cat. No. 52087).

Dikraneura lentrosemae, n. sp.

FIGURES 3, 4

Related to *Dikraneura debilis* McAtee but slightly larger and with a much longer head. A small, slender species without distinct color markings. Length 2.75 mm.

General color pale yellowish-white, sides of thorax and portions of face below antennae pale yellow. Fore wing hyaline with an iridescent golden tinge; apical region with indefinite smoky marks in the form of an oblique dash in the outer apical cell, a spot at the base of the second apical cell, and a faint submarginal stripe.

Crown distinctly longer medially than basal width, disk nearly flat, anterior margin broadly rounded to the face. Pronotum about as long as crown; lateral margins nearly straight, diverging slightly posteriorly; posterior margin shallowly concave. Lateral margins of seventh sternite of female short, posterior margin bluntly, triangularly produced. Male valve small, plates broad basally, tapering to slender upturned tips, length greater than combined basal width.

Sternal apodemes of male unusually long, reaching nearly to middle of sixth segment, apices bluntly rounded. Dorsal spine directed caudad, tip curved downward. Aedeagus with its two slender accessory processes curved upward porteriorly. Style relatively stout, tip curved downward and bluntly pointed. Anal tube with several long, filamentous setae distally.

Holotype male, allotype female, and 1 male and 1 female paratype from Mayagüez, Puerto Rico, Jan. 17, 1936, swept from *Centrosema* (*Bradburya* auct.) by F. M. Wadley. One female paratype from Pueblo Viejo, Puerto Rico, Dec. 18, 1935, collected at light by W. A. Hoffman. Types in colection of the United States National Museum (Cat. No. 52088).

Dikraneura cedrelae, n. sp.

FIGURES 5, 6, 7, 8

Related to *Dikraneura fulva* Osborn but slenderer, not so distinctly flattened, and without the distinctly fulvous ground color. Length 3–3.25 mm.

General ground color pale stramineus above, yellowish-white below. Eyes dull reddish-brown. Fore wing with a pair of smoky-fuscous spots distally, one each in the outer and inner apical cells. Tip of ovipositor sheath black.

Crown only slightly convex, anterior margin bluntly angled medially, median length about twice length next to eye. Pronotum broad, lateral margins nearly straight, posterior margin shallowly concave. Posterior margin of seventh sternite of female irregularly rounded, with a faint notch medially. Male valve unusually large, about one-half as long as its basal width, posterior margin rounded, with a very faint median notch. Male plates rather slender, not contiguous on basal one-half.

Sternal apodemes of male relatively short, reaching to base of fifth segment, apices bluntly rounded. Dorsal spines of male pygofer directly obliquely inward and backward, curving first ventrad and then dorsad. Aedeagus slender, the portion carrying the ejaculatory duct short and curved upward, distal portion of aedeagus consisting of a pair of slender, spine-like processes directed backward and slightly upward. Style broad at middle, distal portion slender, apex slightly broadened.

Fifth-instar nymph broad and distinctly flattened, length 2.75 mm. Crown nearly quadrangular, slightly broader anteriorly, anterior margin with five pairs of short, blunt, tooth-like projections, lateral margins each with a small projection just in front of antenna. Ground color pale stramineus with fuscous to black marks as follows: Narrow anterior border of crown; a transverse row of four spots on crown between antennae, another on base of crown, and one on each of the three thoracic segments; elongate spots on wing pads of fore wings; a basal spot on each wing pad of hind wings; a spot on the lateral margin of each tergite from the third to the eighth inclusive; a pair of small spots near the median line on the eighth tergite; a pair of large spots near the median line on the ninth tergite; a spot covering the tip of the abdomen; small irregular basal spots on both fore and middle tibiae; and a stripe on posterior tibia along base of spines.

Holotype male, allotype female, and numerous paratype including specimens of both sexes from Doña Juana Plantation at Villalba, Puerto Rico, March 2, 1937. Other paratypes from Aibonito, Puerto Rico, March 2, 1937, and Maricao Insular Forest, Maricao, Puerto Rico, Dec. 15, 1937. All specimens collected by L. F. Martorell from *Cedrela odorata L.* Types in collection of the United States National Museum Cat. No. 52089.

Empoasca papayae, n. sp.
FIGURES 9, 10

Size and general form of *Empoasca fabae* (Harr.) but with well developed dorsal spines and with each lateral process having a short, sharp projection just basad of the curved, pointed apex. Length 3–3.25 mm.

General color pale iridescent green with irregular greenish-white areas on head and thorax. Crown slightly less produced anteriorly than in *fabae*. Male plates typical for the genus. The female of what appears to be this species has the posterior margin of the seventh sternite produced and evenly rounded.

Sternal apodemes of male small and inconspicuous. Tergal apodemes irregularly quadrangular in outline, curved ventrad laterally. Dorsal spine straight or nearly so, tapering gradually to a blunt point. Lateral process curving upward in lateral view, with a spine-like projection in a dorso-lateral position just before apex, and apex pointed and strongly recurved. Apex of style sharply pointed, curved laterad distally.

Holotype male and 6 male paratype from Mayagüez, Puerto Rico, March 25, 1937. (P. R. No. 2010). Also 2 male paratype from the same locality, Feb. 5, 1937 (P. R. No. 1789). Nymphs and females associated with the males appear to be the same species. All material collected by J. H. Jensen on *Carica papaya* L., and reported to be associated with the "bunchy-top disease" of papaya. Type in colection of the United States National Museum (Cat. No. 52090).

Explanation of Plates

Fig. 1.—Aedeagus, connective, and styles of *Protalebra brunnea.*

Fig. 2.—Aedeagus, connective, and tyles of *Joruma neascripta.*

Fig. 3.—Sternal apodemes of male of *Dikraneura centrosemae.*

Fig. 4.—Lateral view of male genital capsule of *Dikraneura centrosemae.*

Fig. 5.—Head of fifth instar nymph of *Dikraneura cedrelae.*

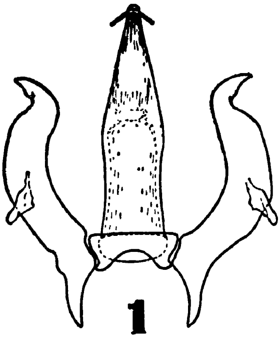
Fig. 6.—Sternal apodemes of male of *Dikraneura cedrelae.*

Fig. 7. Dorsal view of male genital capsule of *Dikraneura cedrelae.*

Fig. 8.—Lateral view of aedeagus of *Dikraneura cedrelae.*

Fig. 9.—Ventral view of male genital capsules of *Empoasca papayae.*

Fig. 10.—Lateral view of male genital capsule of *Empoasca papayae.*



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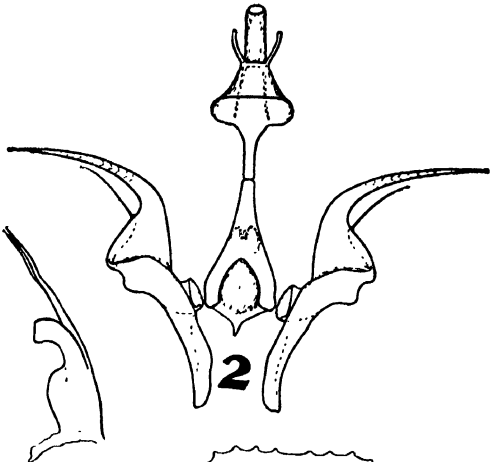

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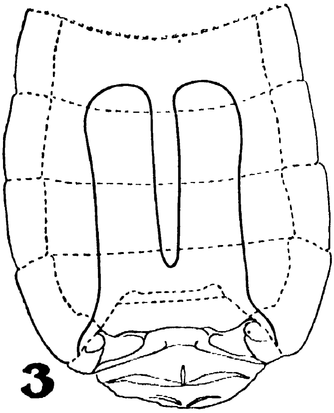

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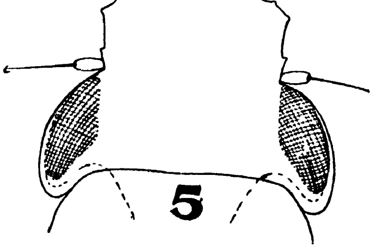

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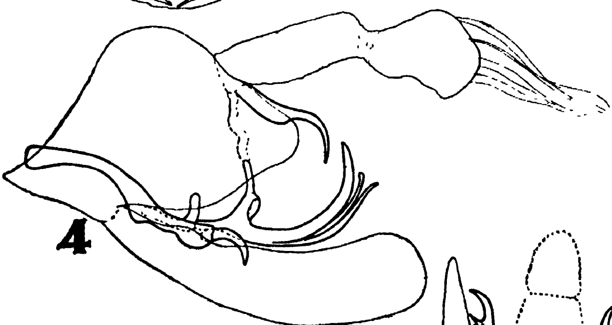

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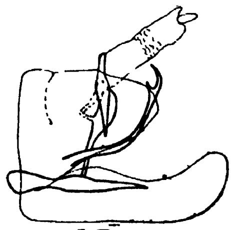

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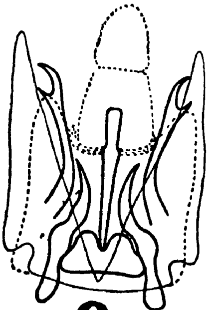

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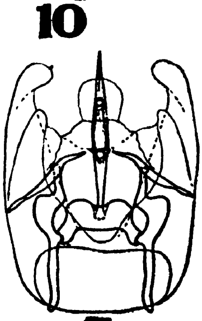

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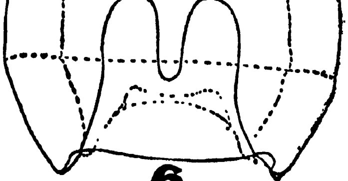


6

A NEW FUNGUS ON *FICUS NITIDA* THUNB

JOHN A. JUMP, *Graduate Student,*
University of Pennsylvania.

While visiting at the Agricultural Experiment Station in Río Piedras during the summer of 1936 the writer became interested in a fungus appearing upon *Ficus nitida* Thunb. which had been sent to the laboratory for identification. Subsequent study of the organism at the botanical laboratory of the University of Pennsylvania indicated that it was an unreported species of *Hypoxylon.* The name *Hypoxylon borinquensis* is proposed by the writer and the species is herewith described:

Hypoxylon borinquensis sp. nov. Stroma latissime effsa, carbonaceo, nitida, subsuperficiale in trunci ramorumque cortice, aliquid scabra propter ostiolis papillis, extus intusque nigrum. Peritheciis prerique, ovoides-oblongis, .2—.4 mm. lata. Ascis cylindraceis, densissime stipatis, brevissime stipatatis, aparaphysatibus, 130–160 $\times$ 7–8μ, octosporis. Sporidiis monostichis, subacutis, fusiformibus v. ovatis, saepe inequalateralbus, subflavis, 16–18 $\times$ 3.5–5μ. Hab. in ramis truncibusque Fici nitidi in Puerto Rico.

Stroma broadly effused, carbonaceous, shining, subsuperficial in bark of the trunk and branches; somewhat rough due to the papillate ostioles; black within and without. Perithecia numerous, avoid-oblong, .2—.4 mm. wide. Asci cylindrical, very densely crowded, very short stiped, 130–160 $\times$ 7–8u, eight spored. Ascospores monostichous, subacute, fusiform or ovate, often inequilateral, yellowish, 16–18 $\times$ 3.5–5μ. Habitat in branches and trunks of Ficus nitida in Puerto Rico.

The stroma in gross form bears some resemblance to both *Eutypa erumpens* Massee and *Nummularia tinctor* Berk. and, since these fungi are also found in many of the islands of the Wset Indies, a careful examination should be made of diseased Ficus in order that the organism involved may be correctly determined. *Eutypa erumpens* has been reported as occurring on *Ficus nitida* and Caçao in Trinidad.

Is is quite diffcult in many cases to identify the genus of a fungus in the group of the *Spheriales* which includes *Eutypa, Diatrype, Hypoxylon* and *Nummularia,* as they are similar in many respects

and have transitional forms of which the generic status is debatable. *Hypoxylon borinquensis* corresponds in certain respects to *Nummularia tinctor* and perhaps should be regarded as a *Nummularia,* but the writer is included to consider *Nummularia* an invalid genus. Ellis & Everhart (1) refer to the genus as being too close to *Hypoxylon* in many of its forms and Miller (2), points out that the conidial layer actually arises in the same manner in both genera, although it was upon this character that the two genera were originally separated. *Nummularia* supposedly possesses a substromal conidial layer which is not found in *Hypoxylon,* but Miller has proved this distinction to be fallacious and concludes: "It is only logical to place the species that were taken out of *Hypoxylon* and placed in *Nummularia* back in *Hypoxylon.*" The writer concurs with this point of view and accordingly has placed the fungus from Ficus in the genus *Hypoxylon.*

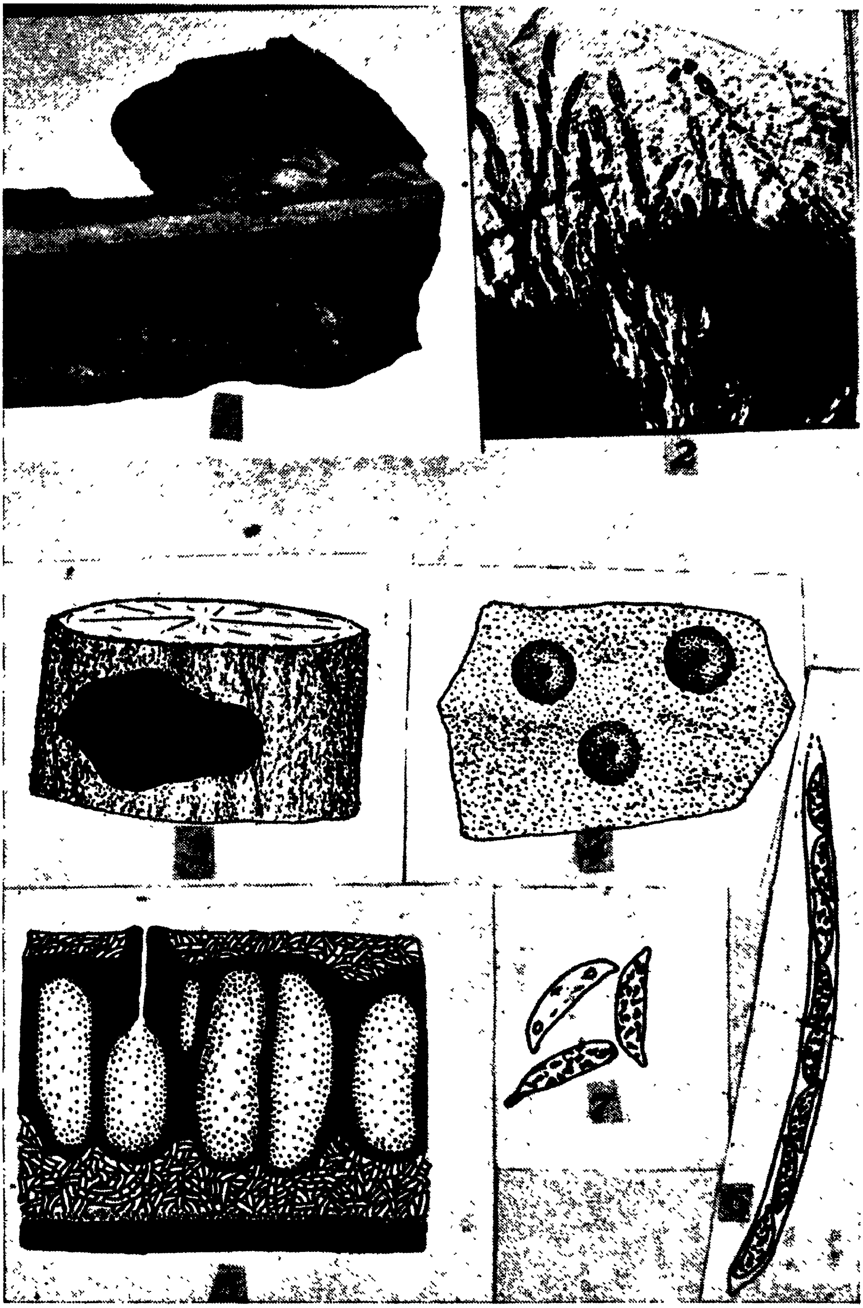
Hypoxylon borinquensis forms an unusually large stroma on its host. The average dimentions were not included in the description. as there was not enough material available to make a significant average, but a single stromatic surface of 1 dm. in width by 1–3 dm. in length might be expected when occurring on a limb or trunk of a sufficiently large diameter.

Botanical Laboratory
University of Pennsylvania
Philadelphia, Pa.

1. **Collens, A. E.** Dept. of Agri. of Trinidad. (n.s.) **61**: 33–43, 1909.
2. **Ellis & Everhart** North American *Pyrenomycetes.* Newfield 1892.
3. **Miller, J. M.** Biologic Studies in the Spheriales. Mycologia **20**: 1928.

Explanation of Plates

Fig. 1.—Stroma on wood of ***Ficus nitida.***
Fig. 2.—Ascospores of ***Hypoxylon borinquensis*** sp. n.
Fig. 3.—Habitat drawing.
Fig. 4.—Surface of stroma showing ostioles. Enlarged.
Fig. 5.—Diagramatic section through stroma. Asci omitted.
Fig. 6.—Ascus of *H. borinquensis.*
Fig. 7.—Ascospores.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THE ANT, *MONOMORIUM CARBONARIUM EBENINUM* FOREL, IN A NEW ROLE: AS PREDATOR ON THE EGG-CLUSTERS OF *DIATRAEA SACCHARALIS* F. IN PUERTO RICAN CANE FIELDS

By
GEORGE N. WOLCOTT, *Entomologist*,
and
LUIS F. MARTORELL, *Assistant Entomologist*,

One-sixth of the nearly 9,000 egg-clusters of the sugar-cane moth-borer, *Diatraea saccharalis* F., collected between September 1936 and September 1937 in the cane fields of Puerto Rico, had been partly or completely devoured by some predaceous animal at the time of observation. The mere presence of a moth-borer egg-mass on the cane leaf often causes the eventual appearance of a chlorotic spot in the leaf tissue, and many such chlorotic spots shaped like egg-clusters were noted but could not be included in the count because no bit of egg-shell remained to prove definitely that an egg-mass had previously rested there. Sometimes the predaceous animal had left the merest rim of chorion; more often the entire lower layer of the egg-shell remained attached to the leaf. Sometimes only part of the egg-cluster had been eaten, and under these circumstances it was possible to note that it apparently made little difference to the animal feeding upon them whether the eggs were fresh and unparasitized, or whether they were black from the attack of *Trichogramma minutum* Riley. Egg-masses from which the caterpillars had hatched, and those from which the parasites had emerged were also often eaten, but rarely consumed so completely and neatly: in many cases they were merely bitten into and messed up.

The observations on the presence of moth-borer egg-clusters were made during each month of the year in every important cane-producing section of the Island. Listing every eaten egg-cluster by localities indicates little difference in geographic distribution. To be sure, the Ponce region with 150 eaten egg-clusters, the Guayama–Yauco region with an equal number and the Guánica–Yauco region with 123, seems to indicate a somewhat greater abundance in the semi-xerophytic South Coast than 120 in the Toa Baja–Dorado region and 107 in

the Arecibo region, but the total of all North Coast observations is more than for the South Coast. Noting all the instances where more than half of all the egg-clusters observed in the field had been eaten indicates quite a chance distribution, as do also the few instances where all egg-clusters had been eaten. The greatest number of eaten egg-clusters collected in an hour was at Toa Baja on February 23, 1937, where, out of a total of 70, those eaten numbered 30.

The differences in the completeness and neatness with which egg-clusters were eaten suggested that more than one kind of organism might be responsible. The Coccinellid beetle, *Cycloneda sanguinea* L., is a common insect in cane fields, being an important predator on the yellow aphis, *Sipha flava* Forbes. Presumably it could eat other bits of animal matter of equivalent size, but it has never been observed in the field feeding on moth-borer eggs, and when confined with them in a cage, did not eat them. The beautiful red and blue Lycid beetle, *Thonalmus chevrolati* Bourgeois, of which nothing is specifically known as to its food-habits (altho they are supposed to be predaceous), is common in fields of young cane in the Guánica region, but, tested in a cage experiment, also gave negative results.

In a field of young ratoon cane near Río Piedras, examined on October 1, 1936 by the junior writer, small black ants were noted feeding on a partly parasitized egg-cluster. Specimens submitted to Dr. M. R. Smith were identified by him as *Monomorium carbonarium* F. Smith, subsp. *ebeninum* Forel. Ants of this species (as determined by the writers) were repeatedly noted subsequently feeding on egg-clusters altho the field notes record only the following: at Isabela on December 23, 1936 eating fresh eggs; at Toa Baja, May 4th, 1937, eating parasitized eggs; at Quebradillas on July 15th, also eating parasitized eggs; and at Yabucoa on July 29th, eating the egg-shells of a hatched cluster. It is possible that some other predator may be responsible for some of the eaten egg-clusters, but at this minute black ant is the only organism which has been actually seen in the field eating the eggs, and as the records show that it feeds on fresh, parasitized and hatched eggs, it would appear probable that it is responsible for most, if not all of the destruction noted. *Monomorium carbonarium ebeninum* is a common ant in all parts of Puerto Rico, living in various places besides cane fields. In cane fields, its previously recorded activities were to nest under the leaf-

sheaths of cane and in moth-borer tunnels in the stalks of cane, and to attend the yellow aphis, *Sipha flava* Forbes. It has not previously been observed feeding on the egg-masses of *Diatraea saccharalis* F., yet the number of them eaten in Puerto Rico is so large that, were this ant more discriminating in its choice of the character of the eggs (whether fresh, parasitized or merely shells) on which it feeds, it would be a factor of importance in the natural control of the moth-borer of sugar-cane. In the fields, or at the times when the wasp parasite, *Trichogramma minutum* Riley, is scarce or absent, however, this ant appears to be the only natural agent tending to reduce their numbers, and, under these conditions and in this phase of its activities, is unquestionably beneficial to the interests of the cane-grower.

THE BRACKISH WATER MOSQUITOES OF PUERTO RICO [1]

By GEORGE S. TULLOCH, *Associate Entomologist,*
Division of Insects Affecting Man and Animals,
Bureau of Entomology and Plant Quarantine

The purpose of this paper is to report on studies concerning the distribution in Puerto Rico of certain species of mosquitoes which breed in brackish waters. These species may be divided into two groups. The first includes those forms which were found in both fresh and brackish waters and the second, those forms found only in brackish waters. Although the tolerance or preference of certain mosquitoes for water containing vaious quantities of salt has been recognized for many years, little attention has been directed to a study of the various species in relation to the salt content of their breeding media. The data on this subject presented here are based on observations made in Puerto Rico during 1935–36.

The salts responsible for the brackish condition of certain mosquito breeding waters in Puerto Rico are derived either from the soil or from the ocean. The salts in the soil have been deposited as a result of the decomposition of organic or inorganic materials, and in certain parts of the coastal plain relatively large amounts are present. It is probable that at one time soil salts were rather generally distributed throughout the entire coastal plain. In regions having heavy rainfall and good drainage, leaching has proceeded to the extent that the soil is suitable for agricultural purposes. In dry, poorly drained areas, such as are found in portions of the southern coastal plain, the leaching process has proceeded at a much slower rate with the result that the soil is unfit for agricultural purposes. In these areas rain or waste irrigation waters accumulate in natural or artificial depressions, salts pass into solution, and a brackish pool suitable for the development of certain mosquitoes results. It is, therefore, not uncommon in Puerto Rico to find the salt-marsh mosquito, *Aedes sollicitans* (Walk.) developing in pools which may be many miles away from the ocean. The area of this habitat is increased during the rainy season and decreased during

[1] These investigations were carried on with special funds available to the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture for studies on insects of Puerto Rico. They were under the technical direction of the Division of Insects Affecting Man and Animals, and conducted in cooperation with the Federal Experiment Station at Mayagüez, where headquarters for the investigations were located.

the dry season. The concentration of the salts in the pools is increased by evaporation and decreased by the addition of water.

In certain regions along the seacoast where the slope is gradual, tidal swamps are present. Brackish water areas are produced by the mixing of ocean water with drainage, rain, and waste irrigation waters, and if other conditions are favorable, breeding of mosquitoes takes place. A similar condition is produced in the rivers at certain seasons. The topograhy of Puerto Rico is such that the rivers arising in the central mountainous regions must traverse a flat coastal plain before reaching the ocean. The flow of the rivers is retarded by the loss of grade in the coastal plain and by sand bars thrown across the river mouths by tides. During the rainy season the rivers are able to maintain channels through the sand bars, but during the dry season the sandbars cause the river waters to become impounded in their own courses. During high tides and storms, waves pass over the sandbars into the impounded fresh waters, causing them to become brackish. In the shallow margins of these impounded brackish areas the development of mosquitoes takes place.

The brackish condition of the mosquito-breeding areas is caused principally by chlorides. The concentration of chlorides, or, rather, the total halogen expressed as chlorine, serves as an indication of the brackish condition of a pool. In pools which receive their salts from the ocean the relation between the halides and the total salinity is definite and is based on the following formula.

$$\text{Salinity} = 0.030 + 1.8050 \text{ Chlorine}$$ [1]

In pools which receive their salts from other sources the halide concentration is not a direct index of the salinity but it serves, nevertheless, as an indication of the brackish condition. Accordingly a quantitative study of the halides was made in pools containing mosquitoes. The halide concentration was determined by volumetric titration and is expressed as parts of chlorine per 100,000 parts of sample.

The following 12 species of mosquitoes were taken in brackish waters in Puerto Rico: *Aedes sollicitans* (Walk.), *A. taeniorhynchus* (Wied.), *Anopheles albimanus* Wied., *A. crucians* Wied., *A. grabhamii* Theob., *Culex atratus* Theob., *C. bahamensis* Dyar and Knab, *C. habilitator* Dyar and Knab, *C. inhibitator* Dyar and Knab, *C. nigripalpus* Theob., and *Psorophora pygmaea* (Theob.), and *Urano-*

[1] Knudsen, M. 1901. Hydrographical Tables. Copenhagen.

taenia sp. Only three of these, *Anopheles crucians, Aedes sollicitans,* and *Culex bahamensis,* were found to be restricted to this habitat, the remaining nine being taken at other times in waters free of chlorides.

It was possible from quantitative field tests to establish provisional chlorine ranges for nine of the species (Table 1). *Culex habilitator* and a species of *Uranotaenia*[1] were found in fresh waters and in brackish waters containing up to 210 parts of chlorine. *Culex nigripalpus, Psorophora pygmaea, Culex inhibitator, Anopheles albimanus,* and *Anopheles grabhamii* have greater ranges, which suggests a greater tolerance for salts. A distinct preference for salts is exhibited by *Culex bahamensis* and *Aedes sollicitans.*

TABLE 1.—PROVISIONAL CHLORINE RANGES OF WATERS IN WHICH VARIOUS SPECIES OF PUERTO RICAN MOSQUITOES[2] WERE FOUND

Species	Parts chlorine per 100,000 parts of sample	Number of collections
Culex habilitator	0–185	8
Uranotaenia sp.	0–210	95
Culex nigripalpus	0–540	20
Psorophora pygmaea	0–765	3
Culex inhibitator	0–770	30
Anopheles albimanus	0–950	111
A. grabhamii	0–950	8
Culex bahamensis	195–900	13
Aedes sollicitans	370–940	11

[1] It is possible that two species of *Uranotaenia* are involved.
[2] Sea water contains approximately 2,000 parts of chlorine per 100,000.

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